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Bulletin	280A/281A	283A	284A	280D/281D	283D	284D	280E/281E	284E
Type	ArmorPoint®			DeviceNet™			EtherNet/IP™	
Horsepower Range:								
0.5…10 Hp (0.37…7.5 kW)	✓	—	—	✓	—	—	✓	—
0.5…10 Hp (0.37…5.5 kW)	—	✓	—	—	✓	—	—	—
0.5…5 Hp (0.4…3.0 kW)	—	—	✓	—	—	✓	—	✓
Starting Method:								
Full-Voltage and Reversing	✓	—	—	✓	—	—	✓	—
Current Limit, Soft Start including Soft Stop	—	✓	—	—	✓	—	—	—
Sensorless Vector Performance	—	—	✓	—	—	✓	—	—
Sensorless Vector Control	—	—	✓	—	—	✓	—	✓
Environmental Rating:								
IP67/NEMA Type 4	✓	✓	✓	✓	✓	✓	✓	✓
NEMA Type 4X	—	—	—	✓	✓	✓	—	—
Control Voltage:								
24V DC	✓	✓	✓	✓	✓	✓	✓	✓
120V AC	✓	✓	✓	✓	✓	✓	—	—
240V AC	✓	✓	✓	✓	✓	✓	—	—
Operational Voltage Ratings:								
200…480V AC	✓	✓	—	✓	✓	—	✓	—
200…240V AC	—	—	✓	—	—	✓	—	—
380…480V AC	—	—	✓	—	—	✓	—	✓
500…575V AC	✓	✓	✓	✓	✓	✓	—	—
Rated for Group Motor Installations	✓	✓	✓	✓	✓	✓	✓	✓
Local logic using DeviceLogix™	✓	✓	✓	✓	✓	✓	✓	✓
I/O Capability:								
Four Inputs	—	—	—	✓	✓	✓	✓	✓
Two Outputs	✓	✓	✓	✓	✓	✓	✓	✓
Network Communications:								
ControlNet™	✓	✓	✓	—	—	—	—	—
DeviceNet	✓	✓	✓	✓	✓	✓	—	—
EtherNet/IP	✓	✓	✓	—	—	—	✓	✓
I/O Expansion with ArmorPoint Distributed I/O Products	✓	✓	✓	—	—	—	—	—
LED Status Indication	✓	✓	✓	✓	✓	✓	✓	✓
Gland Plate Entry:								
Conduit Entrance	✓	✓	✓	✓	✓	✓	✓	✓
ArmorConnect® Power Media	✓	✓	✓	✓	✓	✓	✓	✓
Quick Disconnects (I/O, Communications, Motor Connection, Three-Phase and Control Power)	✓	✓	✓	✓	✓	✓	✓	✓
Extended Length Motor and Brake Cables	✓	✓	✓	✓	✓	✓	✓	✓
Factory Installed Options:								
HOA Keypad	✓	✓	✓	✓	✓	✓	✓	✓
Safety Monitor	✓	✓	✓	✓	✓	✓	—	—
Control Brake Contactor	—	—	✓	—	—	✓	—	—
Source Brake Contactor	—	✓	✓	—	✓	✓	—	✓
Dynamic Brake Connector	—	—	✓	—	—	✓	—	✓
Output Contactor	—	—	✓	—	—	✓	—	✓
EMI Filter	—	—	✓	—	—	✓	—	✓
Shielded Motor Cable	—	—	✓	—	—	✓	—	✓
0…10V Analog Input	—	—	✓	—	—	✓	—	—
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Product Line Description

The ArmorStart Distributed Motor Controller is an integrated, pre-engineered, motor starter solution for On-Machine applications. The ArmorStart offers as standard, a robust IP67/NEMA Type 4 enclosure design, which is suitable for water wash-down environments. Specific solutions may also be offered with NEMA Type 4X rating, suitable for caustic wash down environments. Its modular design offers simplicity in wiring using quick disconnects for the I/O, communications, and motor connection. Optional quick disconnects for control and three-phase power, fully integrates the plug-n-play solution. As standard, the ArmorStart offers four inputs and two outputs to be used with sensors and actuators. The ArmorStart Distributed Motor Controller offers as standard, a local at-motor disconnect means by incorporating the Bulletin 140M Motor Circuit Protector. This eliminates the need for additional components that would otherwise be required in each motor branch circuit. The ArmorStart Distributed Motor Controllers are listed as suitable for Group Motor installations.

Features

Network and I/O Capabilities
The ArmorStart Distributed Motor Controller delivers enhanced control and parameter configuration, device status, fault diagnostics, and remote start/stop control. DeviceNet or EtherNet/IP are standard communication protocols. The ArmorPoint Bus version provides additional flexibility in communication and I/O options.

EtherNet/IP Version includes: Embedded dual port switch that supports Device Level Ring (DLR), DHCP or static IP address configuration, ControlLogix add-on profile, embedded web server, four configurable 24V DC inputs with status indication, two solid–state outputs with status indication, and IEEE Transparent Clock.

DeviceNet Version includes: Four configurable 24V DC inputs with status indication, two relay outputs with status indication, ControlLogix add-on profile, and standardized HMI faceplates.

ArmorPoint Bus Backplane Version Includes: DeviceNet, ControlNet, or EtherNet communication protocols, expandable I/O and specialty modules, two relay outputs with status indication, and a maximum of two ArmorPoint Distributed Motor Controllers per ArmorPoint Distributed I/O network module.

DeviceLogix - Local logic control
DeviceLogix provides local control over the device's discrete and network I/O. It consists of function blocks, inputs, outputs, and actual hardware data, including fault and status bits.

Zone Interlocking Parameters (Peer-to-Peer)
Zone Interlocking Parameters (ZIP) allow peer-to-peer communication and control across multiple zones. ZIP allows one ArmorStart to consume data directly from up to three other DeviceNet nodes without going through the network scanner. These direct communications between conveyor zones are beneficial in a merge, diverter, and accumulation conveyor applications. (Not available with EtherNet/IP)

Gland Plate Entrance
The ArmorStart product offers two different methods for connecting incoming three-phase and control power to the device. One method offered is the traditional conduit entrance, which provides a 3/4 and 1 in. conduit hole opening for wiring three-phase and control power. The second method offers connectivity to the ArmorConnect power media. Factory-installed receptacles are provided for connectivity to both three-phase and control power media.

LED Status Indication
The LED Status Indication provides four status LEDs and a reset button. The LEDs provide status indication for the following:

- POWER LED
- RUN LED
- NETWORK LED
- FAULT LED

Reset Button
This is used as a local trip reset.

Motor Cable
A 3-meter unshielded, 4-conductor cordset is provided with every ArmorStart Distributed Motor Controller.

Modes of Operation

Bulletin 280 or 281 Full Voltage/Reversing Starter
This method is used in applications requiring across-the-line starting. The ArmorStart Bulletin 280 offers full-voltage starting, and the Bulletin 281 offers full-voltage starting for reversing applications.

Bulletin 283 Solid-State Motor Starter
Soft Start
The motor is raised from an initial torque value to full torque over a preset time. This initial torque is adjustable to 15, 25, 35, or 65% of locked rotor torque. The motor voltage is gradually increased during the acceleration ramp time, which can be adjusted from 1…45 s.
Current Limit Start
This starting mode is used when it is necessary to limit the maximum starting current. It can be adjusted for 150…450% of full load amps. Start times are selectable from 1…45 s.
Selectable Kick Start
A kickstart, or boost, at the beginning of the start mode is intended to provide a current pulse of 450% of the full load current. The kickstart time is adjustable from 0.5…1.5 s. This allows the motor to develop additional torque at startup for loads that may need an initial boost.
Soft Stop
The Soft Stop function can be used with applications that require an extended coast to rest. When enabled, the voltage ramp-down time can be selected from 1…90 s. The motor will stop when the motor voltage drops to a point where the load torque is greater than the motor torque.

Bulletin 284 Variable Frequency Drive
Sensorless Vector Performance (Volts per Hertz)
This method provides excellent speed regulation and high levels of torque across the entire speed range of the drive, and improved speed regulation even as loading increases. Basic control yields the most cost-effective performance when sensorless vector control is not required.
Sensorless Vector Control (SVC)
Sensorless vector control provides exceptional speed regulation and very high levels of torque across the entire speed range of the drive. Optimized Performance:

- Removable MOV provides trouble-free operation when used on ungrounded distribution systems.
- A relay pre-charge limits inrush current.
- Integral brake transistor provides dynamic braking capability using low cost IP20 brake resistors or IP67 plug and play resistors.
- 150% overload for 60 seconds or 200% overload for 3 seconds provides robust overload protection.
- Adjustable PWM frequency up to 16 kHz ensures quiet operation.

280/281 ArmorStart Distributed Motor Controller

- On-Machine starting solution
- Full-voltage and reversing
- Horsepower range 0.5…10 Hp (0.37…7.5 kW)
- Robust IP67/NEMA Type 4 or NEMA Type 4X enclosure rating
- Quick disconnect connections for I/O, communications, motor, three-phase and control power
- Gland plate entry: conduit entrance or ArmorConnect power media
- LED status indication
- EtherNet/IP, DeviceNet, or ControlNet communications
- Local logic technology using DeviceLogix
- Peer-to-peer communication (ZIP) (not available with EtherNet communications)
- Connectivity to ArmorPoint distributed I/O products
- Factory installed options:
  - Hand/Off/Auto (HOA) keypad configuration
  - Safety monitor

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Standards Compliance

UL 508
CSA C22.2, No. 14
EN/IEC 60947-4
EN/IEC 60947-4-1
CE Marked per Low Voltage Directive 2006/95/EC and EMC Directive 2004/108/EC
CCC
ODVA for EtherNet/IP and DeviceNet

Certifications

cULus (File No. E3125, Guides NLDX, NLDX7)

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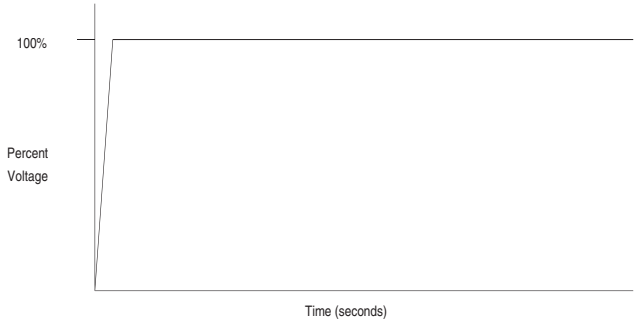
Mode of Operation

Full-Voltage Start

This method is used in applications requiring across-the-line starting. Full in-rush current and locked-rotor torque are realized. The ArmorStart Bulletin 280 offers full-voltage starting, and the Bulletin 281 offers full-voltage starting for reversing applications.



Overload Protection

The Bulletin 280/281 ArmorStart Distributed Motor Controller incorporates, as standard, electronic motor overload protection. This overload protection is accomplished electronically with an I^2t algorithm. The ArmorStart's overload protection is programmable via the communication network providing the user with flexibility. The overload trip class can be selected for class 10, 15, or 20 protection. Ambient insensitivity is inherent in the electronic design of the overload.

Fault Diagnostics

Fault diagnostics capabilities built in the ArmorStart Distributed Motor Controller:

- Short Circuit
- Overload
- Phase Loss
- Control Power Loss
- Control Power Fuse Detection
- I/O Fault
- Output Power Fuse Detection
- Overtemperature
- Phase Imbalance
- DeviceNet Power Loss
- EEPROM Fault
- Hardware Fault

Factory-Installed Options

HOA Selector Keypad

The HOA Selector Keypad allows local start/stop control.

Safety Monitor

The Safety Monitor Option allows independent monitoring of the output status of the device. The function is implemented using a normally closed contact which complies with IEC 60947-5-1 for mechanically linked contacts. Two terminal blocks are provided as the inputs which maybe used with an external safety circuit. The external safety circuit monitors the status of the isolation contactor.

Catalog Number Explanation

Examples given in this section are for reference purposes. This basic explanation should not be used for product selection; not all combinations will produce a valid catalog number.

280	D	–	F	12Z	–	10	C	–	CR	–	Option 1	–	Option 2
a	*b*		*c*	*d*		*e*	*f*		*g*		*h*		*i*

a

Bulletin Number	
Code	Description
280	Full-Voltage Starter
281	Reversing Starter

b

Communications	
Code	Description
A	ArmorPoint
D	DeviceNet
E	EtherNet/IP

c

Enclosure Type	
Code	Description
F	Type 4 (IP67)
S❄	Type 4X

d

Contactor Size/Control Voltage§		
24V DC	120V AC	240V AC
12Z	12D	12B
23Z	23D	23B

e

Short Circuit Protection (Motor Circuit Protector)	
Code	Description
10	10 A Rated Device
25	25 A Rated Device

f

Overload Selection Current Range	
Code	Description
A	0.24…1.2 A
B	0.5…2.5 A
C	1.1…5.5 A
D	3.2…16 A

g

Control and 3-Phase Power Connections/Motor Cable Connection (CR: Conduit/Round Media) or (RR: Round/Round Media)				
Code		Description		
		Control Power	3-Phase Power	Motor Cable
CR	blank	Conduit Entrance	Conduit Entrance	3 m, unshielded cordset male 90°
CR	W ∗	Conduit Entrance	Conduit Entrance	No cable
RR	blank	Round Media (Male Receptacle)	Round Media (Male Receptacle)	3 m, unshielded cordset male 90°
RR	W ∗	Round Media (Male Receptacle)	Round Media (Male Receptacle)	No cable

h

Option 1	
Code	Description
3	Hand/Off/Auto Selector Keypad
3FR	Hand/Off/Auto Selector Keypad with Forward/Reverse

i

Option 2	
Code	Description
SM‡	Safety Monitor

∗ See Accessories on page 4-82 for extended motor cable lengths.
❄ Not available with EtherNet/IP or ArmorPoint versions.
‡ Not available with EtherNet/IP version, also not available with round media option (RR).
§ See Product Selection tables for additional information.

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EtherNet/IP Network Communication

Full-voltage starters — IP67/NEMA Type 4 with conduit entrance, Up to 480V AC

Current Rating [A]	kW		Hp			24V DC Control Voltage
	230V AC, 50 Hz	400V AC, 50 Hz	200V AC, 60 Hz	230V AC, 60 Hz	460V AC, 60 Hz	Cat. No.
0.24…1.2	0.18	0.37	—	—	0.5	280E-F12Z-10A-CR
0.5…2.5	0.37	0.75	0.5	0.5	1	280E-F12Z-10B-CR
1.1…5.5	1.1	2.2	1	1	3	280E-F12Z-10C-CR
3.2…16	4	7.5	3	5	10	280E-F23Z-25D-CR

Full-voltage starters — IP67/NEMA Type 4 with ArmorConnect power media connections, Up to 480V AC

Current Rating [A]	kW		Hp			24V DC Control Voltage
	230V AC, 50 Hz	400V AC, 50 Hz	200V AC, 60 Hz	230V AC, 60 Hz	460V AC, 60 Hz	Cat. No.
0.24…1.2	0.18	0.37	—	—	0.5	280E-F12Z-10A-RR
0.5…2.5	0.37	0.75	0.5	0.5	1	280E-F12Z-10B-RR
1.1…5.5	1.1	2.2	1	1	3	280E-F12Z-10C-RR
3.2…16	4	7.5	3	5	10	280E-F23Z-25D-RR

Reversing starters — IP67/NEMA Type 4 with conduit entrance, Up to 480V AC

Current Rating [A]	kW		Hp			24V DC Control Voltage
	230V AC, 50 Hz	400V AC, 50 Hz	200V AC, 60 Hz	230V AC, 60 Hz	460V AC, 60 Hz	Cat. No.
0.24…1.2	0.18	0.37	—	—	0.5	281E-F12Z-10A-CR
0.5…2.5	0.37	0.75	0.5	0.5	1	281E-F12Z-10B-CR
1.1…5.5	1.1	2.2	1	1	3	281E-F12Z-10C-CR
3.2…16	4	7.5	3	5	10	281E-F23Z-25D-CR

Reversing starters — IP67/NEMA Type 4 with ArmorConnect power media connections, Up to 480V AC

Current Rating [A]	kW		Hp			24V DC Control Voltage
	230V AC, 50 Hz	400V AC, 50 Hz	200V AC, 60 Hz	230V AC, 60 Hz	460V AC, 60 Hz	Cat. No.
0.24…1.2	0.18	0.37	—	—	0.5	281E-F12Z-10A-RR
0.5…2.5	0.37	0.75	0.5	0.5	1	281E-F12Z-10B-RR
1.1…5.5	1.1	2.2	1	1	3	281E-F12Z-10C-RR
3.2…16	4	7.5	3	5	10	281E-F23Z-25D-RR

DeviceNet Network Communications

Full-voltage starters — IP67/NEMA Type 4 with conduit entrance, Up to 575V AC

Current Rating [A]	kW		Hp				24V DC Control Voltage	120V AC Control Voltage	240V AC Control Voltage
	230V AC 50 Hz	400V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	575V AC 60 Hz	Cat. No.	Cat. No.	Cat. No.
0.24…1.2	0.18	0.37	—	—	0.5	0.5	280D-F12Z-10A-CR	280D-F12D-10A-CR	280D-F12B-10A-CR
0.5…2.5	0.37	0.75	0.5	0.5	1	1.5	280D-F12Z-10B-CR	280D-F12D-10B-CR	280D-F12B-10B-CR
1.1…5.5	1.1	2.2	1	1	3	3	280D-F12Z-10C-CR	280D-F12D-10C-CR	280D-F12B-10C-CR
3.2…16	4	7.5	3	5	10	10	280D-F23Z-25D-CR	280D-F23D-25D-CR	280D-F23B-25D-CR

Full-voltage starters — IP67/NEMA Type 4 with ArmorConnect power media connections, Up to 575V AC

Current Rating [A]	kW		Hp				24V DC Control Voltage	120V AC Control Voltage	240V AC Control Voltage
	230V AC 50 Hz	400V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	575V AC 60 Hz	Cat. No.	Cat. No.	Cat. No.
0.24…1.2	0.18	0.37	—	—	0.5	0.5	280D-F12Z-10A-RR	280D-F12D-10A-RR	280D-F12B-10A-RR
0.5…2.5	0.37	0.75	0.5	0.5	1	1.5	280D-F12Z-10B-RR	280D-F12D-10B-RR	280D-F12B-10B-RR
1.1…5.5	1.1	2.2	1	1	3	3	280D-F12Z-10C-RR	280D-F12D-10C-RR	280D-F12B-10C-RR
3.2…16	4	7.5	3	5	10	10	280D-F23Z-25D-RR	280D-F23D-25D-RR	280D-F23B-25D-RR

DeviceNet Network Communication, Continued

Full-voltage starters — NEMA Type 4X with conduit entrance, Up to 575V AC

Current Rating [A]	kW		Hp				24V DC Control Voltage	120V AC Control Voltage	240V AC Control Voltage
	230V AC 50 Hz	400V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	575V AC 60 Hz	Cat. No.	Cat. No.	Cat. No.
0.24…1.2	0.18	0.37	—	—	0.5	0.5	280D-S12Z-10A-CR	280D-S12D-10A-CR	280D-S12B-10A-CR
0.5…2.5	0.37	0.75	0.5	0.5	1	1.5	280D-S12Z-10B-CR	280D-S12D-10B-CR	280D-S12B-10B-CR
1.1…5.5	1.1	2.2	1	1	3	3	280D-S12Z-10C-CR	280D-S12D-10C-CR	280D-S12B-10C-CR
3.2…16	4	7.5	3	5	10	10	280D-S23Z-25D-CR	280D-S23D-25D-CR	280D-S23B-25D-CR

Full-voltage starters — NEMA Type 4X with ArmorConnect power media connections, Up to 575V AC

Current Rating [A]	kW		Hp				24V DC Control Voltage	120V AC Control Voltage	240V AC Control Voltage
	230V AC 50 Hz	400V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	575V AC 60 Hz	Cat. No.	Cat. No.	Cat. No.
0.24…1.2	0.18	0.37	—	—	0.5	0.5	280D-S12Z-10A-RR	280D-S12D-10A-RR	280D-S12B-10A-RR
0.5…2.5	0.37	0.75	0.5	0.5	1	1.5	280D-S12Z-10B-RR	280D-S12D-10B-RR	280D-S12B-10B-RR
1.1…5.5	1.1	2.2	1	1	3	3	280D-S12Z-10C-RR	280D-S12D-10C-RR	280D-S12B-10C-RR
3.2…16	4	7.5	3	5	10	10	280D-S23Z-25D-RR	280D-S23D-25D-RR	280D-S23B-25D-RR

Reversing starters — IP67/NEMA Type 4 with conduit entrance, Up to 575V AC

Current Rating [A]	kW		Hp				24V DC Control Voltage	120V AC Control Voltage	240V AC Control Voltage
	230V AC 50 Hz	400V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	575V AC 60 Hz	Cat. No.	Cat. No.	Cat. No.
0.24…1.2	0.18	0.37	—	—	0.5	0.5	281D-F12Z-10A-CR	281D-F12D-10A-CR	281D-F12B-10A-CR
0.5…2.5	0.37	0.75	0.5	0.5	1	1.5	281D-F12Z-10B-CR	281D-F12D-10B-CR	281D-F12B-10B-CR
1.1…5.5	1.1	2.2	1	1	3	3	281D-F12Z-10C-CR	281D-F12D-10C-CR	281D-F12B-10C-CR
3.2…16	4	7.5	3	5	10	10	281D-F23Z-25D-CR	281D-F23D-25D-CR	281D-F23B-25D-CR

Reversing starters — IP67/NEMA Type 4 with ArmorConnect power media connections, Up to 575V AC

Current Rating [A]	kW		Hp				24V DC Control Voltage	120V AC Control Voltage	240V AC Control Voltage
	230V AC 50 Hz	400V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	575V AC 60 Hz	Cat. No.	Cat. No.	Cat. No.
0.24…1.2	0.18	0.37	—	—	0.5	0.5	281D-F12Z-10A-RR	281D-F12D-10A-RR	281D-F12B-10A-RR
0.5…2.5	0.37	0.75	0.5	0.5	1	1.5	281D-F12Z-10B-RR	281D-F12D-10B-RR	281D-F12B-10B-RR
1.1…5.5	1.1	2.2	1	1	3	3	281D-F12Z-10C-RR	281D-F12D-10C-RR	281D-F12B-10C-RR
3.2…16	4	7.5	3	5	10	10	281D-F23Z-25D-RR	281D-F23D-25D-RR	281D-F23B-25D-RR

Reversing starters — NEMA Type 4X with conduit entrance, Up to 575V AC

Current Rating [A]	kW		Hp				24V DC Control Voltage	120V AC Control Voltage	240V AC Control Voltage
	230V AC 50 Hz	400V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	575V AC 60 Hz	Cat. No.	Cat. No.	Cat. No.
0.24…1.2	0.18	0.37	—	—	0.5	0.5	281D-S12Z-10A-CR	281D-S12D-10A-CR	281D-S12B-10A-CR
0.5…2.5	0.37	0.75	0.5	0.5	1	1.5	281D-S12Z-10B-CR	281D-S12D-10B-CR	281D-S12B-10B-CR
1.1…5.5	1.1	2.2	1	1	3	3	281D-S12Z-10C-CR	281D-S12D-10C-CR	281D-S12B-10C-CR
3.2…16	4	7.5	3	5	10	10	281D-S23Z-25D-CR	281D-S23D-25D-CR	281D-S23B-25D-CR

Reversing starters — NEMA Type 4X with ArmorConnect power media connections, Up to 575V AC

Current Rating [A]	kW		Hp				24V DC Control Voltage	120V AC Control Voltage	240V AC Control Voltage
	230V AC 50 Hz	400V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	575V AC 60 Hz	Cat. No.	Cat. No.	Cat. No.
0.24…1.2	0.18	0.37	—	—	0.5	0.5	281D-S12Z-10A-RR	281D-S12D-10A-RR	281D-S12B-10A-RR
0.5…2.5	0.37	0.75	0.5	0.5	1	1.5	281D-S12Z-10B-RR	281D-S12D-10B-RR	281D-S12B-10B-RR
1.1…5.5	1.1	2.2	1	1	3	3	281D-S12Z-10C-RR	281D-S12D-10C-RR	281D-S12B-10C-RR
3.2…16	4	7.5	3	5	10	10	281D-S23Z-25D-RR	281D-S23D-25D-RR	281D-S23B-25D-RR

ArmorPoint Bus Network Communication

Full-voltage starters — IP67/NEMA Type 4 with conduit entrance, Up to 575V AC

Current Rating [A]	kW		Hp				24V DC Control Voltage	120V AC Control Voltage	240V AC Control Voltage
	230V AC 50 Hz	400V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	575V AC 60 Hz	Cat. No.	Cat. No.	Cat. No.
0.24…1.2	0.18	0.37	—	—	0.5	0.5	280A-F12Z-10A-CR	280A-F12D-10A-CR	280A-F12B-10A-CR
0.5…2.5	0.37	0.75	0.5	0.5	1	1.5	280A-F12Z-10B-CR	280A-F12D-10B-CR	280A-F12B-10B-CR
1.1…5.5	1.1	2.2	1	1	3	3	280A-F12Z-10C-CR	280A-F12D-10C-CR	280A-F12B-10C-CR
3.2…16	4	7.5	3	5	10	10	280A-F23Z-25D-CR	280A-F23D-25D-CR	280A-F23B-25D-CR

Full-voltage starters — IP67/NEMA Type 4 with ArmorConnect power media connections, Up to 575V AC

Current Rating [A]	kW		Hp				24V DC Control Voltage	120V AC Control Voltage	240V AC Control Voltage
	230V AC 50 Hz	400V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	575V AC 60 Hz	Cat. No.	Cat. No.	Cat. No.
0.24…1.2	0.18	0.37	—	—	0.5	0.5	280A-F12Z-10A-RR	280A-F12D-10A-RR	280A-F12B-10A-RR
0.5…2.5	0.37	0.75	0.5	0.5	1	1.5	280A-F12Z-10B-RR	280A-F12D-10B-RR	280A-F12B-10B-RR
1.1…5.5	1.1	2.2	1	1	3	3	280A-F12Z-10C-RR	280A-F12D-10C-RR	280A-F12B-10C-RR
3.2…16	4	7.5	3	5	10	10	280A-F23Z-25D-RR	280A-F23D-25D-RR	280A-F23B-25D-RR

Reversing starters — IP67/NEMA Type 4 with conduit entrance, Up to 575V AC

Current Rating [A]	kW		Hp				24V DC Control Voltage	120V AC Control Voltage	240V AC Control Voltage
	230V AC 50 Hz	400V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	575V AC 60 Hz	Cat. No.	Cat. No.	Cat. No.
0.24…1.2	0.18	0.37	—	—	0.5	0.5	281A-F12Z-10A-CR	281A-F12D-10A-CR	281A-F12B-10A-CR
0.5…2.5	0.37	0.75	0.5	0.5	1	1.5	281A-F12Z-10B-CR	281A-F12D-10B-CR	281A-F12B-10B-CR
1.1…5.5	1.1	2.2	1	1	3	3	281A-F12Z-10C-CR	281A-F12D-10C-CR	281A-F12B-10C-CR
3.2…16	4	7.5	3	5	10	10	281A-F23Z-25D-CR	281A-F23D-25D-CR	281A-F23B-25D-CR

Reversing starters — IP67/NEMA Type 4 with ArmorConnect power media connections, Up to 575V AC

Current Rating [A]	kW		Hp				24V DC Control Voltage	120V AC Control Voltage	240V AC Control Voltage
	230V AC 50 Hz	400V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	575V AC 60 Hz	Cat. No.	Cat. No.	Cat. No.
0.24…1.2	0.18	0.37	—	—	0.5	0.5	281A-F12Z-10A-RR	281A-F12D-10A-RR	281A-F12B-10A-RR
0.5…2.5	0.37	0.75	0.5	0.5	1	1.5	281A-F12Z-10B-RR	281A-F12D-10B-RR	281A-F12B-10B-RR
1.1…5.5	1.1	2.2	1	1	3	3	281A-F12Z-10C-RR	281A-F12D-10C-RR	281A-F12B-10C-RR
3.2…16	4	7.5	3	5	10	10	281A-F23Z-25D-RR	281A-F23D-25D-RR	281A-F23B-25D-RR

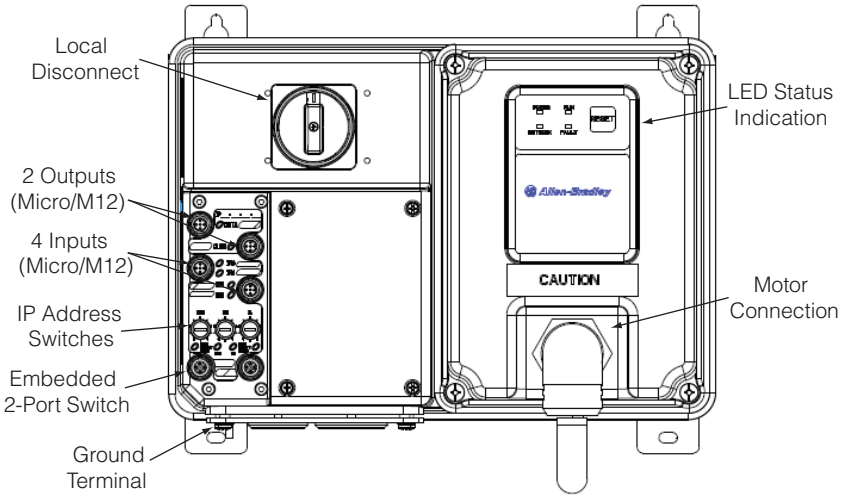
Options — Factory Installed

Description		Cat. No. Modification
	Hand/Off/Auto Selector Keypad (Bulletin 280)	-3
	Hand/Off/Auto Selector Keypad with Forward/Reverse Function (Bulletin 281)	-3FR
	Safety Monitor❄‡	-SM
	Supplied ArmorStart without motor cable	-CRW
	ArmorConnect Power Media Connectivity, ArmorStart supplied without motor cable	-RRW

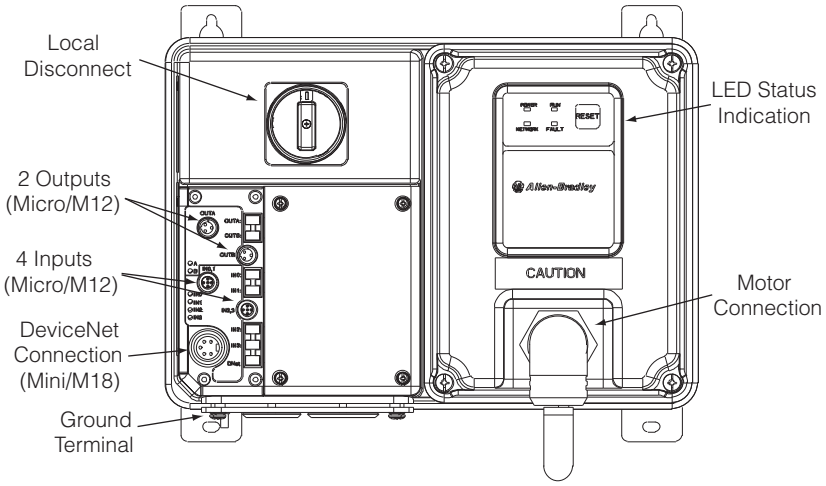
❄ Not available with EtherNet/IP version.
‡ Not available with round media option (RR).

Connections

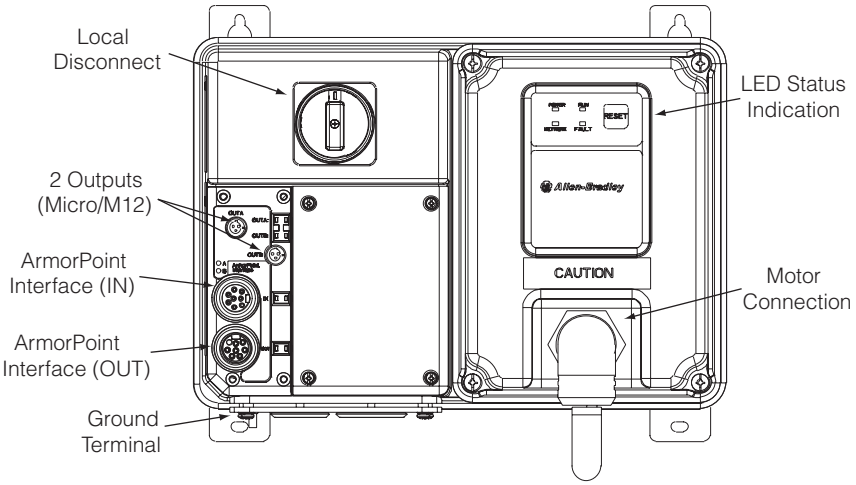
Bulletin 280E/281E ArmorStart with EtherNet/IP Communications



Bulletin 280D/281D ArmorStart with DeviceNet Communications



Bulletin 280A/281A ArmorStart for the ArmorPoint Backplane



ArmorStart Receptacle Pin Outs

Receptacle Connections for ArmorPoint Interface (OUT)

Pin 1: CAN high
Pin 2: Common
Pin 3: +5V
Pin 4: CAN low
Pin 5: Enable out
Pin 7: Common
Pin 8: NC (no connection)

Receptacle Connections for ArmorPoint Interface (IN)

Pin 1: CAN high
Pin 2: Common
Pin 3: +5V
Pin 4: CAN low
Pin 5: Enable out
Pin 7: Common
Pin 8: PE

Receptacle Connections for DeviceNet Connector

Pin 1: Drain (no connection)
Pin 2: +VDNET
Pin 3: -VDNET
Pin 4: CAN_H
Pin 5: CAN_L

Receptacle Connections for EtherNet/IP (M12)

Pin 1: Tx+
Pin 2: Rx+
Pin 3: Tx-
Pin 4: Rx-

Receptacle Connections for Input (M12)

Pin 1: +24V (A3 or DNET)
Pin 2: Input 0
Pin 3: Common
Pin 4: Input 1
Pin 5: NC (no connection)

Receptacle Connections for Output, EtherNet/IP Version (M12)

Pin 1: NC (no connection)
Pin 2: NC (no connection)
Pin 3: Common
Pin 4: Output +24V DC (A1)
Pin 5: NC (no connection)

Receptacle Connections for Output, DeviceNet or ArmorPoint Version (M12)

Pin 1: PE
Pin 2: Return
Pin 3: Relay out

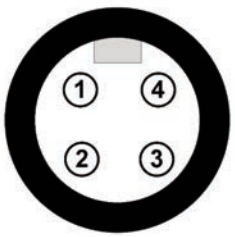
Receptacle Connections for Incoming Control Power

Pin 1: Unswitched (A3)(red)
Pin 2: Common (A2)(black)
Pin 3: PE (green)
Pin 4: Not used (blank)
Pin 5: Switched (A1)(blue)
Pin 6: Not used (white)

Receptacle Connections for Motor Connector - 3 Hp or less (M22)

Pin 1: T1 (black)
Pin 2: T2 (white)
Pin 3: T3 (red)
Pin 4: Ground (green/yellow)

Receptacle Connections for Motor Connector - 10 Hp (M35)



Pin 1: T1 (black)
Pin 2: Ground (green/yellow)
Pin 3: T3 (red)
Pin 4: T2 (white)

ArmorStart Receptacle Pin Outs, Continued

Receptacle Connections for Incoming 3-phase Power - 10 A Short Circuit Protection (M22)

Pin 1: L1 (black)
Pin 2: L2 (white)
Pin 3: L3 (red)
Pin 4: Ground (green/yellow)

Receptacle Connections for Incoming 3-phase Power - 25 A Short Circuit Protection (M35)

Pin 1: L1 (black)
Pin 2: Ground (green/yellow)
Pin 3: L3 (red)
Pin 4: L2 (white)

Electrical Ratings		UL/NEMA		IEC			
Power Circuit	Rated Operation Voltage	200…575V		200…575V			
	Rate Insulation Voltage	600V		600V			
	Rated Impulsed Voltage	6 kV		6 kV			
	Dielectric Withstand	2200V AC		2500V AC			
	Operating Frequency	50/60 Hz		50/60 Hz			
	Utilization Category	N/A		AC-3			
	Protection Against Shock	N/A		IP2X			
	Rated Operating Current Max.	280_-___-10A-*	1.2 A				
		280_-___-10B-*	2.5 A				
		280_-___-10C-*	5.5 A				
		280_-___-10D-*	16 A				
Control Circuit	Rated Operation Voltage	24V DC (+10%, -15%) A2 (should be grounded at voltage source)					
		120V AC (+10%, -15%) A2 (should be grounded at voltage source)					
		240V AC (+10%, -15%) A2 (should be grounded at voltage source)					
	Rate Insulation Voltage	250V		250V			
	Rated Impulsed Voltage	—		4 kV			
	Dielectric Withstand	1500V AC		2000V AC			
	Overvoltage Category	—		III			
	Operating Frequency	50/60 Hz					
Short Circuit Protection	SCPD Performance Type 1	**Current Rating**	**Voltage**	480Y/277V	480Y/480V	600Y/347V	600V
		0.24…1.2 A	Sym. Amps RMS	65 kA	65 kA	30 kA	30 kA
		0.5…2.5 A					
		1.1…5.5 A					
		3.2…16 A		30 kA	30 kA	30 kA	30 kA
	SCPD List	Size per NFPA 70 (NEC) or NFPA 79 for Group Motor Applications					

		UL/NEMA	IEC
Environmental	Operating Temperature Range	-20…+40 °C (-4…+104 °F)	
	Storage and Transportation Temperature Range	–25….+85 °C (–13…+185 °F)	
	Altitude	2000 m	
	Humidity	5…95% (non-condensing)	
	Pollution Degree	3	
	Enclosure Ratings	NEMA 4/12/13	IP67
		NEMA 4X‡	IP69K
	Approximate Shipping Weight	18.1 kg (40 lb)	
Mechanical	**Resistance to Shock**		
	Operational	15 G	
	Non-Operational	30 G	
	Resistance to Vibration		
	Operational	1 G, 0.15 mm (0.006 in.) displacement	
	Non-Operational	2.5 G, 0.38 mm (0.015 in.) displacement	
	Power and Ground Terminals		
	Wire Size	Primary/Secondary terminal: (#16 …#10 AWG)	Primary/Secondary terminal: 1.5…4.0 mm^2
	Tightening Torque	Primary terminal: 10.8 lb•in Secondary terminal: 4.5 lb•in	Primary Terminal: (1.2 N•m) Secondary terminal: (0.5 N•m)
	Wire Strip Length	0.35 in. (9 mm)	
	Control and Safety Monitor Inputs		
	Wire Size	#18…#10 AWG	1.0…4.0 mm^2
	Tightening Torque	6.2 lb•in	0.7 N•m
	Wire Strip Length	0.35 in. (9 mm)	
	Disconnect Lock Out	Maximum of 5/16 in. (8 mm) lock shackle or hasp. The hasp should not exceed 5/16 in. (8 mm) when closed, or damage will occur to disconnect guard.	
EMC Emission Levels	Conducted Radio Frequency Emissions	10V rms Communication cables 10V rms (PE) 150 KHz…80 MHz	
	Radiated Emissions	Class A	
EMC Immunity Levels	Electrostatic Discharge	4 kV contact and 8 kV Air	
	Radio Frequency Electromagnetic Field	10V/m, 80 KHz…1 GHz 3V/m, 1.4 GHz…2.0 GHz 1V/m, 2.0 GHz…2.7 GHz	
	Fast Transient	2 kV (Power) 2 kV (PE) 1 kV (Communications and control)	
	Surge Transient	1 kV (12) $_{L-L}$, 2 kV (2) $_{L-N}$ (earth)	
Overload Rating	Overload Current Range	280_-___-10A-*	0.24…1.2 A
		280_-___-10B-*	0.5…2.5 A
		280_-___-10C-*	1.1…5.5 A
		280_-___-10D-*	3.2…16 A
	Trip Classes	10, 15, 20	
	Trip Rating	120% of FLC setting	
	Number of poles	3	
Standards Compliance		UL 508; CSA C22.2, No. 14; EN/IEC 60947-4; EN/IEC 60947-4-1; CE Marked per Low Voltage 2006/95/EC; EMC Directive 2004/108/EC; CCC; ODVA for EtherNet/IP; ODVA for DeviceNet	
Certifications		cULus (File No. E3125, Guides NLDX, NLDX7)	

‡ Used when caustic chemicals are used in food and beverage applications. The wash down rating is 1000 psi.

ArmorPoint and DeviceNet Versions - Control and I/O Power Requirements							
	Units	W/O HOA			W/ HOA		
Control Voltage	Volts	24V DC	120V AC	240V AC	24V DC	120V AC	240V AC
Contactor (Pick Up)	Amps	0.71	0.583	0.292	0.71	0.583	0.292
Contactor (Hold In)	Amps	0.063	0.075	0.038	0.063	0.075	0.038
Total Control Power (Pick Up)	VA (W)	(17 W)	70	70	(21 W)	83	84
Total Control Power (Hold In)	VA (W)	(1.50 W)	9	9	(5.58 W)	22	23
External Devices powered by Control Voltage							
Outputs (2) (1 A max. each)	Amps	2	2	2	2	2	2
Total Control (Pick Up) with max outputs	VA (W)	(65 W)	310	550	(73 W)	336	579
Total Control (Hold In) with max outputs	VA (W)	(50 W)	249	489	(58 W)	275	518

		UL/NEMA	IEC
Input Ratings	Rated Operation Voltage	24V DC	
	Input On-State Voltage Range	10…26V DC	
	Input On-State Current	3.0 mA @ 10V DC	
		7.2 mA @ 24V DC	
	Input Off-State Voltage Range	0…5V DC	
	Input Off-State Current	<1.5 mA	
	Input Filter — Software Selectable		
	Off to On	Settable from 0…64 ms in 1 ms increments	
	On to Off	Settable from 0…64 ms in 1 ms increments	
	Input Compatibility	N/A	IEC 1+
	Number of Inputs	4	
	Sensor Source		
	Voltage Status Only	11…25V DC from DeviceNet	
	Current Available	50 mA max. per input, 200 mA total	
Output Ratings (Sourced from Control Circuit)	Rated Operation Voltage	240V AC/30V DC	240V AC/30V DC
	Rate Insulation Voltage	250V	250V
	Dielectric Withstand	1500V AC	2000V AC
	Operating Frequency	50/60 Hz	50/60 Hz
	Type of Control Circuit	Electromechanical relay	
	Type of Current	AC/DC	
	Conventional Thermal Current Ith	Total of both outputs ≤ 2 A	
	Type of Contacts	Normally open (N.O.)	
	Number of Contacts	2	
DeviceNet Specifications	DeviceNet Supply Voltage Rating	Range 11…25V DC, 24V DC nominal	
	DeviceNet Input Current	167 mA @ 24V DC - 4.0 W	
	DeviceNet Input Current	364 mA @ 11V DC - 4.0 W	
	External Devices powered by DeviceNet	Sensors inputs 4 x 50 mA - total 200 mA	
	Total w/max Sensor Inputs (4)	367 mA @ 24V DC - 8.8 W	
	DeviceNet Input Current Surge	15 A for 250 µs	
DeviceNet Communications	Baud Rates	125, 250, 500 kbps	
	Distance Maximum	500 m (1630 ft) @ 125 kbps	
	Distance Maximum	200 m (656 ft) @ 250 kbps	
	Distance Maximum	100 m (328 ft) @ 500 kbps	
ArmorPoint Ratings	Backplane Current Load	400 mA	

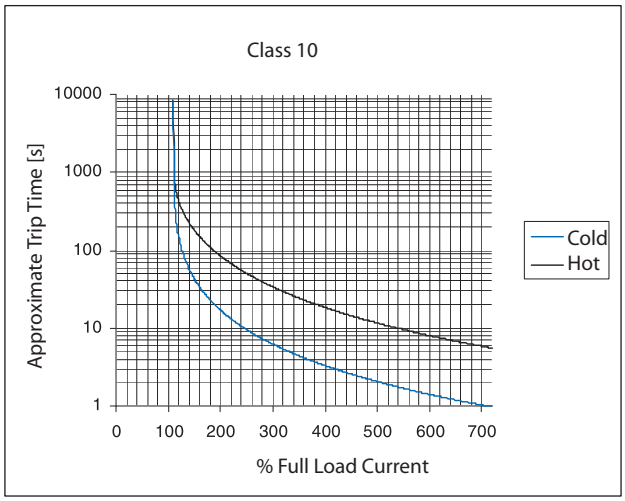
EtherNet/IP Version - Control and I/O Power Requirements						
		A1/A2✶	A3/A2❄	A1/A2✶	A3/A2❄	A3/A2‡
	Units	W/O HOA		W/ HOA		
Control Voltage	Volts	24V DC				
Module Inrush	Amps	0.92	0.30	1.09	0.125	0.295
Module Steady	Amps	0.06	0.30	0.23	0.125	0.295
Total Control Power (Pick Up)	Watts	22.08	7.20	26.16	3.00	7.08
Total Control Power (Running)	Watts	1.44	7.20	5.52	3.00	7.08

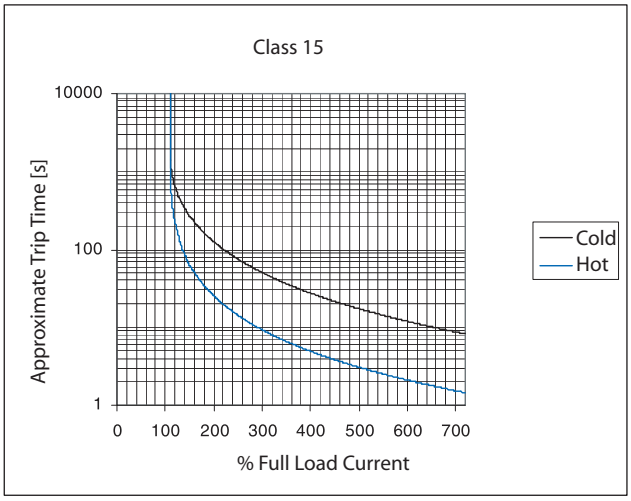
✶ Add power requirements for outputs (1 A max.) to A1/A2.
❄ Add power requirements for inputs (200 mA max.) to A3/A2.
‡ If A1 power is disconnected.

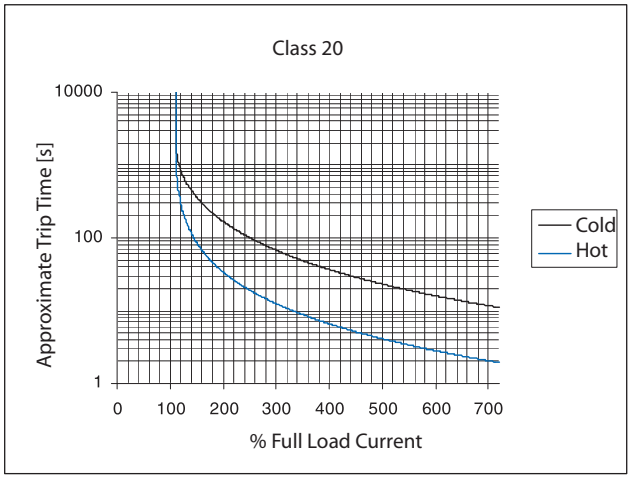
		UL/NEMA	IEC
Input Ratings Sourced from control circuit - A3/A2	Rated Operation Voltage	24V DC	
	Input On-State Voltage Range	10…26V DC	
	Input On-State Current	3.0 mA @ 10V DC	
		7.2 mA @ 24V DC	
	Input Off-State Voltage Range	0…5V DC	
	Input Off-State Current	<1.5 mA	
	Input Filter — Software Selectable		
	Off to On	Settable from 0…64 ms in 1 ms increments	
	On to Off	Settable from 0…64 ms in 1 ms increments	
	Input Compatibility	N/A	IEC 1+
	Number of Inputs	4	
	Sensor Source		
	Voltage Status Only	11…26.4V DC from DeviceNet	
	Current Available	50 mA max. per input, 200 mA total	
Output Ratings Sourced from Control Circuit - A1/A2	Rated Operation Voltage	26.4V DC	
	Rate Insulation Voltage	250V	
	Dielectric Withstand	1500V AC (UL)	2000V AC (IEC)
	Type of Control Circuit	Solid state sourcing output	
	Type of Current	24V DC	
	Conventional Thermal Current Ith	0.5 A each, 1 A max. combined	
	Type of Contacts	Normally open (N.O.)	
	Number of Contacts	2	
	Load Types	Resistive or light inductive	
	Surge Suppression	Integrated diode, clamps @ 35V DC	
	Thermo-Protection	Integrated short circuit and over current protection	
	Maximum Cycle Rate	30 operations/minute capacitive and inductive loads	
	Maximum Blocking Voltage	35V DC	
	Maximum On-State Voltage @ Maximum Output	1.5V DC	
	Maximum Off-State Leakage Current	10 µA	
Device Level Ring (DLR)		Beacon-based performance including IEEE 1588 end to end transparent clock	
	Maximum Nodes	50	
	Fault Recovery	Ring recovery time is less than 3 ms for a 50 node network	
EtherNet Port	EtherNet Receptacles	2 D-coded, 4-pin female M12 connecters	
	Ports	Embedded switch with 2 ports	
	IP Address	DHCP enabled by default	
	DHCP Timeout	30 seconds	
	Communication Rate	10/100 Mbs with auto negotiate half duplex and full duplex	
	Data	• Transported over both TCP and UDP • Min. of 500 I/O packets/second (pps) • Supports up to 150 concurrent TCP sockets	
Web Server		Embedded web server	
	Security	Login and password configurable	
	E-mail	Support Simple Mail Transfer Protocol (SMTP)	
	Configuration	Status, diagnostics, and configuration tabs	
Device Connections		Supports scheduled (Class 1) and unscheduled (Class 3 & UCMM) connections	
		6 - Class 3 connections are supported simultaneously	
		Minimum of 1 - Class 1 or maximum of 2 - Class 1, CIP connections (1 exclusive owner, 1 input only and 1 listen only) are supported	
		Class 1 Connection API: 2…3200 ms, Class 3 Connection API: 100…10 000 ms	
		20 ms Request Packet Interval (RPI) default	
		3 concurrent Encapsulation sessions	
		TCP port supports 5 concurrent incoming connections	

Motor Overload Trip Curves

Motor overload current parameter provides class 10,15, and 20 overload protection. Ambient insensitivity is inherent in the electronic design of the overload.

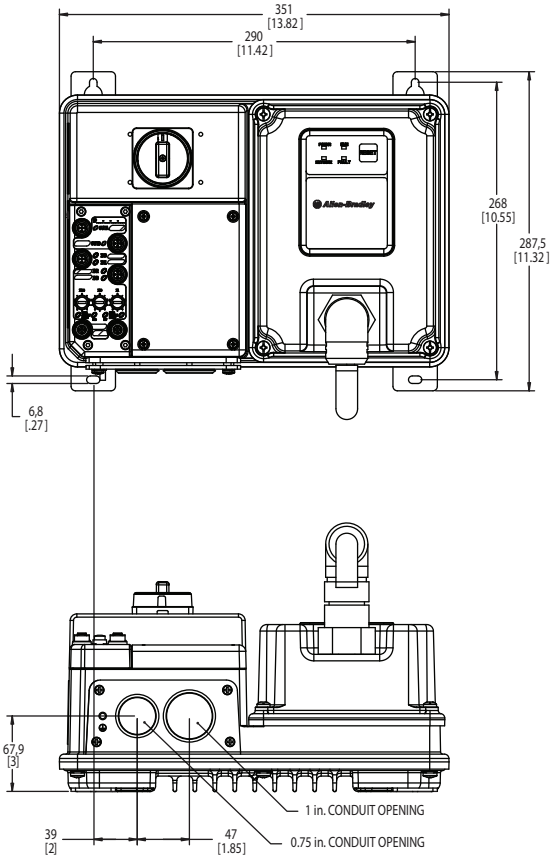


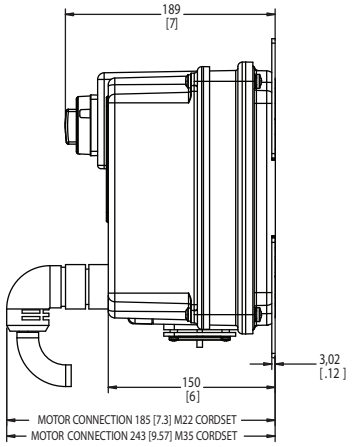


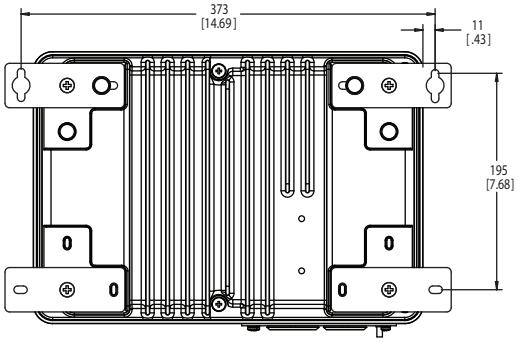


Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.

Dimensions for IP67/NEMA Type 4 with Conduit Entrance

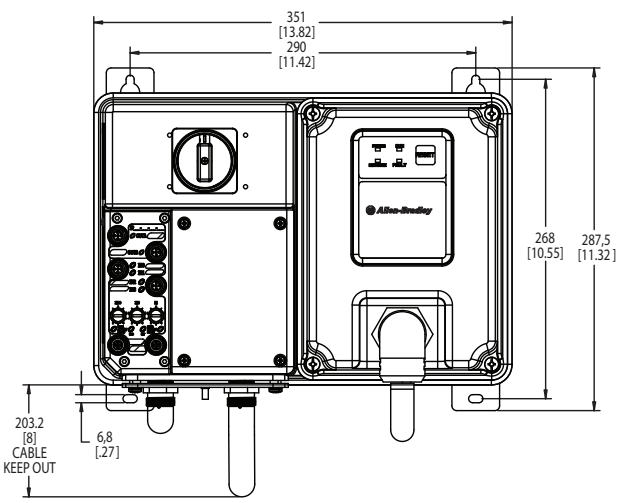


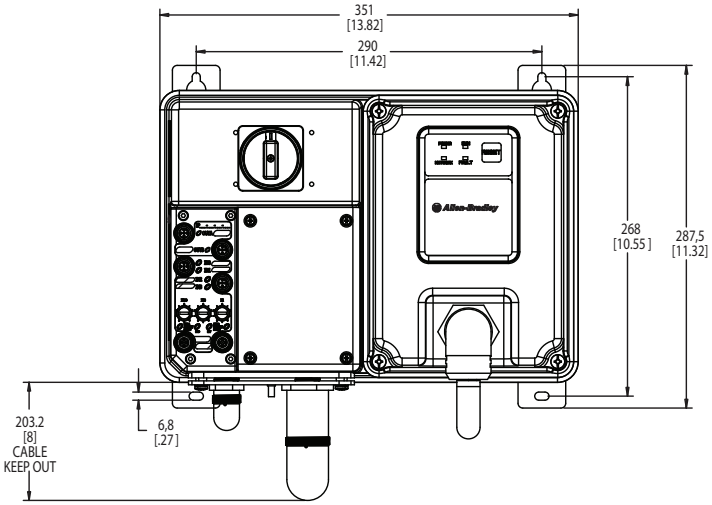


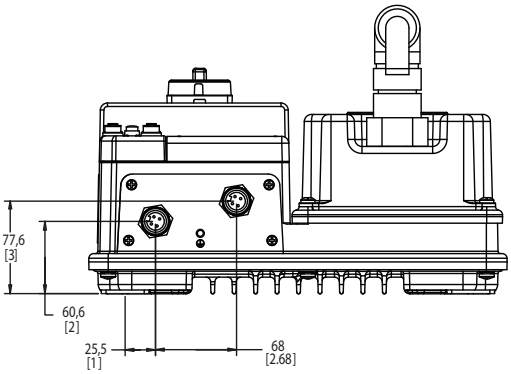


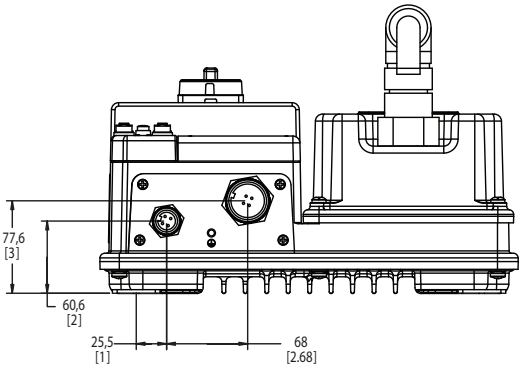
Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.

Dimensions for IP67/NEMA Type 4 with ArmorConnect Connectivity





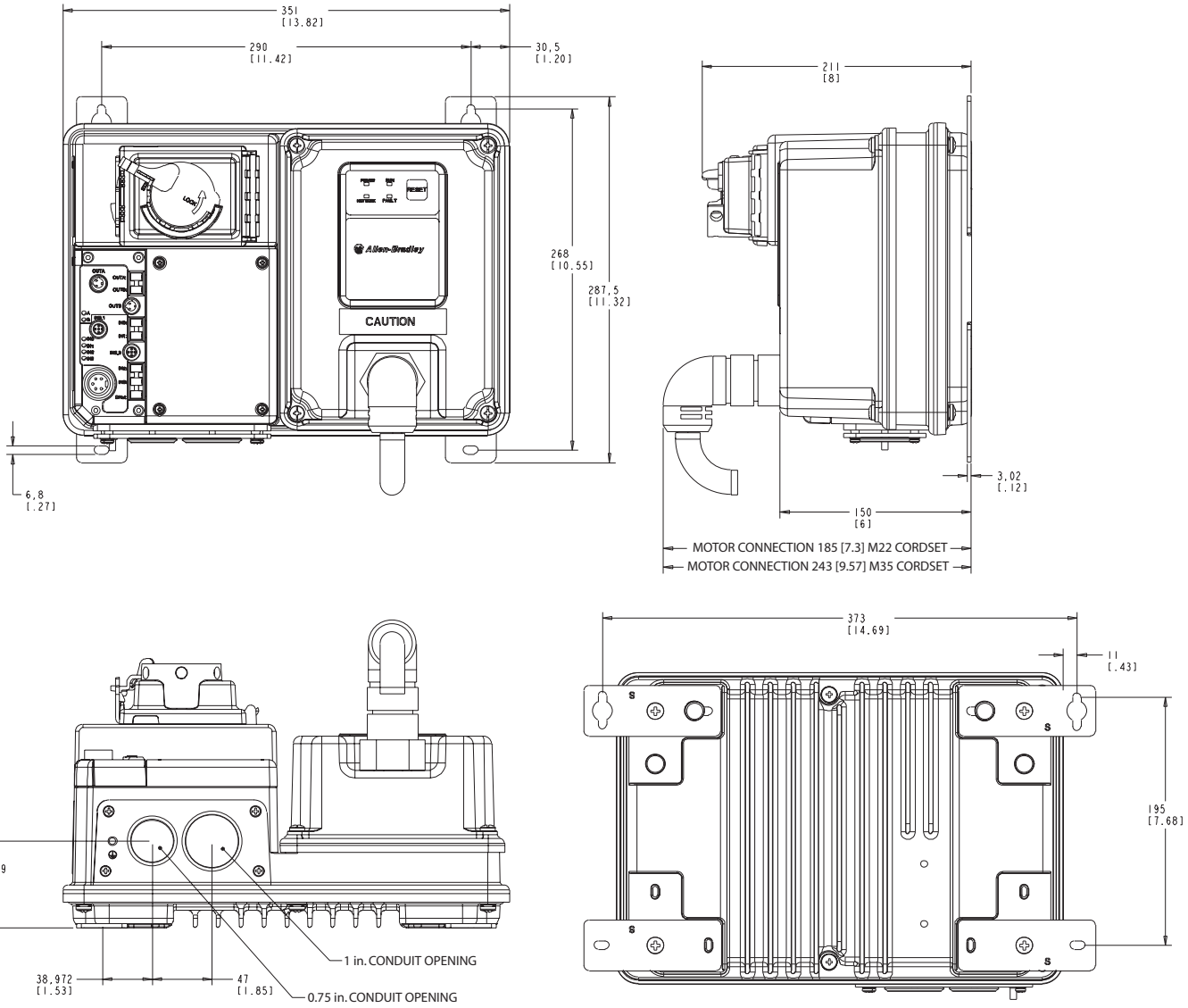




Approximate Dimensions

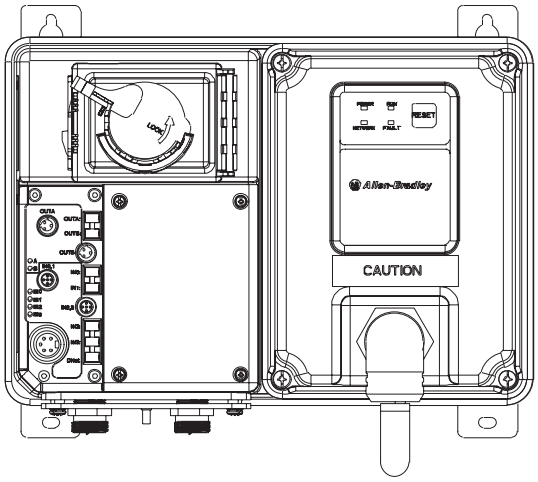
Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.

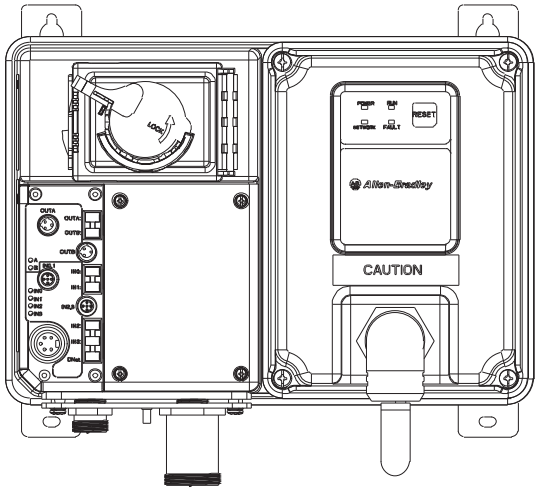
Dimensions for NEMA Type 4X with Conduit Entrance

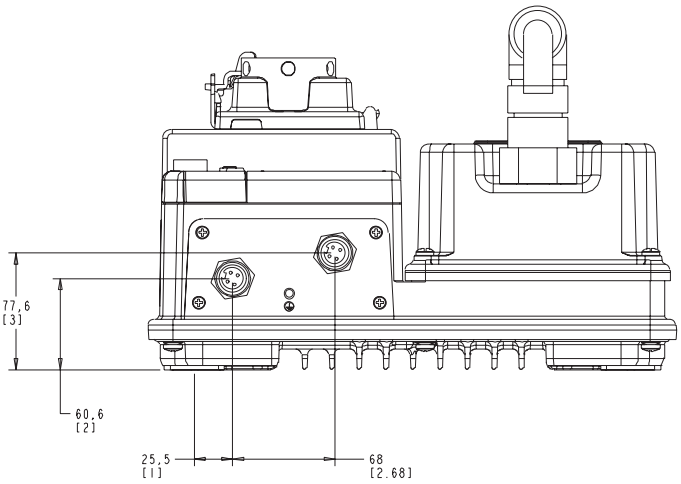


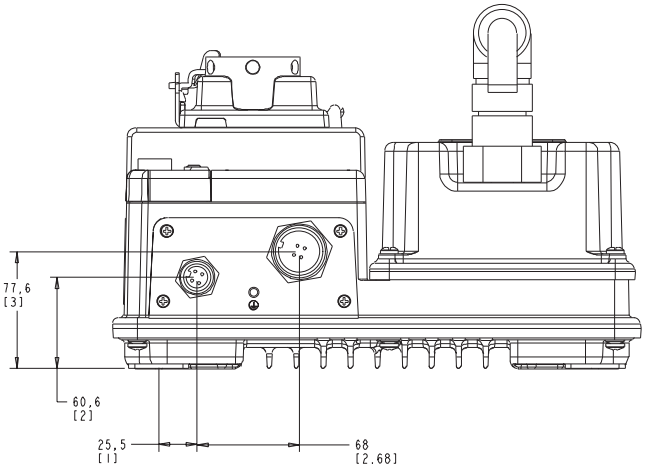
Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.

Dimensions for NEMA Type 4X with ArmorConnect Connectivity









Bulletin 283 ArmorStart Distributed Motor Controller

- On-Machine starting solution
- Solid-state motor control
- Horsepower range 0.5…10 Hp (0.37…5.5 kW)
- Robust IP67/NEMA Type 4 or NEMA Type 4X enclosure rating
- Quick disconnect connections for I/O, communications, motor, three-phase and control power
- Gland plate entry: conduit entrance or ArmorConnect power media
- Four inputs and two outputs (expandable with ArmorPoint)
- LED status indication
- EtherNet/IP, DeviceNet, or ControlNet communications
- Local logic technology using DeviceLogix
- Connectivity to ArmorPoint distributed I/O products
- Peer-to-peer communication (ZIP)
- Factory installed options:
  - Hand/Off/Auto (HOA) keypad configuration
  - Source brake contactor
  - Safety monitor

Table of Contents

Product Selection 4-22
Options 4-24
Accessories 4-79
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Standards Compliance

UL 508
CSA C22.2, No. 14
EN/IEC 60947
EN/IEC 60947-1
CE Marked per Low Voltage Directive 2006/95/EC and EMC Directive 2004/108/EC
CCC
ODVA for DeviceNet

Certifications

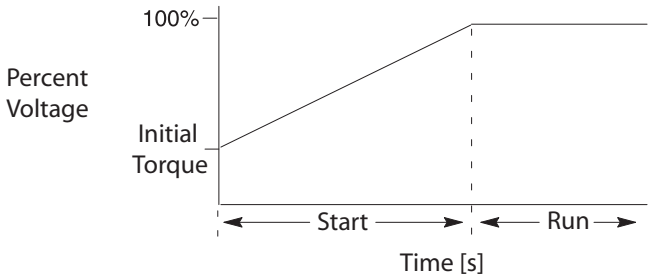
cULus (File No. E96956, Guides NMFT, NMFT7)

4

Mode of Operation

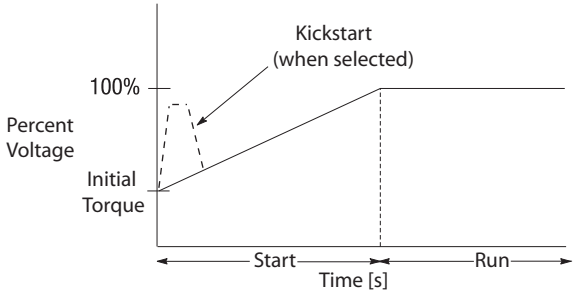
Soft Start

This method has the most general application. The motor is raised from an initial torque value to full voltage. This initial torque is adjustable to 15, 25, 35, or 65% of locked rotor torque. The motor voltage is gradually increased during the acceleration ramp time, which can be adjusted from 1…45 s.



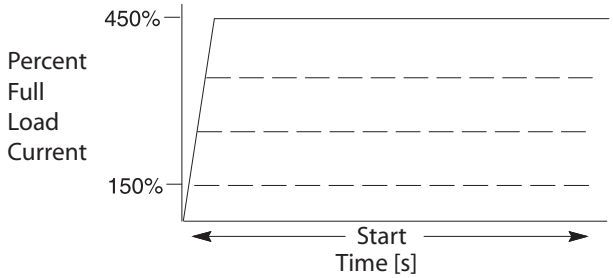
Selectable Kick Start

A kickstart, or boost, at the beginning of the start mode is intended to provide a current pulse of 450% of the full load current. The kickstart time is adjustable from 0.5…1.5 s. This allows the motor to develop additional torque at startup for loads which may need an initial boost.



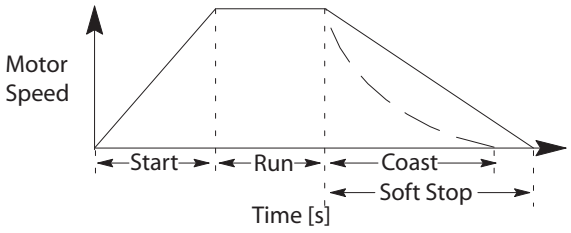
Current Limit Start

This starting mode is used when it is necessary to limit the maximum starting current. It can be adjusted for 150…450% of full load amps. Start times are selectable from 1…45 s.



Soft Stop

The Soft Stop function can be used with applications that require an extended coast to rest. When enabled, the voltage ramp-down time can be selected from 1…90 s. The motor will stop when the motor voltage drops to a point where the load torque is greater than the motor torque.



Overload Protection

The Bulletin 283 ArmorStart Distributed Motor Controller incorporates, as standard, electronic motor overload protection. This overload protection is accomplished electronically with an I^2t algorithm. The ArmorStart's overload protection is programmable via the communication network providing the user with flexibility. The overload trip class allows for Class 10 overload protection. Ambient insensitivity is inherent in the electronic design of the overload.

Fault Diagnostics

Fault diagnostics capabilities built into the Bulletin 283 ArmorStart Distributed Motor Controller help you pinpoint a problem for easy troubleshooting and quick re-starting.

- Short Circuit
- Overload
- Phase Loss
- Shorted SCR
- Phase Rotation
- Control Power Loss
- Control Power Fuse Detection
- DeviceNet Power Loss
- Output Fuse Detection
- I/O Fault
- Brake Fuse Detection
- Overtemperature
- Phase Imbalance
- Internal Communication Fault
- Heatsink Temperature Fault
- EEPROM Fault
- Hardware Fault

Factory-Installed Options

HOA Selector Keypad

The HOA Selector Keypad allows for local start/stop control.

Source Brake Contactor

An internal contactor is used to switch the electromechanical motor brake On/Off. The motor brake is powered from the main power circuit. A customer-accessible 3.0 A fuse is provided to protect the brake cable. Included is a 3-meter 3-pin cordset for connection to the motor brake, as standard.

Safety Monitor

The Safety Monitor Option allows for independent monitoring of the output status of the device. The function is implemented using a normally closed contact which complies with IEC 60947-5-1 for mechanically linked contacts. Two terminal blocks are provided as the inputs which maybe used with an external safety circuit. The external safety circuit monitors the status of the isolation contactor.

Catalog Number Explanation

Examples given in this section are for reference purposes. This basic explanation should not be used for product selection; not all combinations will produce a valid catalog number.

283	D	–	F	B	19Z	–	25	D	–	CR	–	Option 1	–	Option 2	–	Option 3
a	*b*		*c*	*d*	*e*		*f*	*g*		*h*		*i*		*j*		*k*

a

Bulletin Number	
Code	Description
283	Solid-State Starter

b

Communications	
Code	Description
D	DeviceNet
A	ArmorPoint

c

Enclosure Type	
Code	Description
F	Type 4 (IP67)
S	Type 4X

d

Input Line Voltage	
Code	Description
B	200…460V AC, 3-Phase, 50/60 Hz
C	200…575V AC, 3-Phase, 50/60 Hz

e

Controller Size/Control Voltage§		
24V DC	120V AC	240V AC
3Z	3D	3B
9Z	9D	9B
16Z	16D	16B
19Z	19D	19B

f

Short Circuit Protection (Motor Circuit Protector)	
Code	Description
10	10 A Rated Device
25	25 A Rated Device

g

Overload Selection Current Range	
Code	Description
A	1.1…3.0 A
B	3.0…5.5 A
C	5.3…7.6 A
D	6.3…16.0 A

i

Option 1	
Code	Description
3	Hand/Off/Auto Selector Keypad

j

Option 2		
Code		Description
SB	blank	Source Brake Contactor
SB	W ∗	No cable

k

Option 3	
Code	Description
SM❄	Safety Monitor

h

Control and 3-Phase Power Connections/Motor Cable Connection (CR: Conduit/Round Media) or (RR: Round/Round Media)				
Code		Description		
		Control Power	3-Phase Power	Motor Cable
CR	blank	Conduit Entrance	Conduit Entrance	3 m, unshielded cordset male 90°
CR	W ∗	Conduit Entrance	Conduit Entrance	No cable
RR	blank	Round Media (Male Receptacle)	Round Media (Male Receptacle)	3 m, unshielded cordset male 90°
RR	W ∗	Round Media (Male Receptacle)	Round Media (Male Receptacle)	No cable

∗ See Accessories on page 4-82 for extended motor and source brake cable lengths.
❄ Not available with round media option (RR).
§ See Product Selection tables for additional information.

Product Selection

DeviceNet Network Communication

IP67/NEMA Type 4 with conduit entrance, Up to 480V AC

	kW		Hp			24V DC Control Voltage	120V AC Control Voltage	240V AC Control Voltage
Current Rating [A]	230V AC 50 Hz	380/ 400/ 415V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	Cat. No.	Cat. No.	Cat. No.
1.1…3.0	0.37	1.1	0.5	0.5	1.5	283D-FB3Z-10A-CR	283D-FB3D-10A-CR	283D-FB3B-10A-CR
3.0…5.5	1.5	2.2	1	1	3	283D-FB9Z-10B-CR	283D-FB9D-10B-CR	283D-FB9B-10B-CR
5.3…7.6	3	3	1.5	2	5	283D-FB16Z-10C-CR	283D-FB16D-10C-CR	283D-FB16B-10C-CR
6.3…16	4	5.5	3	5	10	283D-FB19Z-25D-CR	283D-FB19D-25D-CR	283D-FB19B-25D-CR

NEMA Type 4X with conduit entrance, Up to 480V AC

	kW		Hp			24V DC Control Voltage	120V AC Control Voltage	240V AC Control Voltage
Current Rating [A]	230V AC 50 Hz	380/ 400/ 415V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	Cat. No.	Cat. No.	Cat. No.
1.1…3.0	0.55	1.1	0.5	0.5	1.5	283D-SB3Z-10A-CR	283D-SB3D-10A-CR	283D-SB3B-10A-CR
3.0…5.5	1.1	2.2	1	1	3	283D-SB9Z-10B-CR	283D-SB9D-10B-CR	283D-SB9B-10B-CR
5.3…7.6	1.5	3	1.5	2	5	283D-SB16Z-10C-CR	283D-SB16D-10C-CR	283D-SB16B-10C-CR
6.3…16	4	5.5	3	5	10	283D-SB19Z-25D-CR	283D-SB19D-25D-CR	283D-SB19B-25D-CR

DeviceNet Network Communication, Continued

IP67/NEMA Type 4 with quick disconnects for ArmorConnect power media, Up to 480V AC

Current Rating [A]	kW		Hp			24V DC Control Voltage	120V AC Control Voltage	240V AC Control Voltage
	230V AC 50 Hz	380/ 400/ 415V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	Cat. No.	Cat. No.	Cat. No.
1.1…3.0	0.55	1.1	0.5	0.5	1.5	283D-FB3Z-10A-RR	283D-FB3D-10A-RR	283D-FB3B-10A-RR
3.0…5.5	1.1	2.2	1	1	3	283D-FB9Z-10B-RR	283D-FB9D-10B-RR	283D-FB9B-10B-RR
5.3…7.6	1.5	3	1.5	2	5	283D-FB16Z-25C-RR	283D-FB16D-10C-RR	283D-FB16B-10C-RR
6.3…16	4	5.5	3	5	10	283D-FB19Z-25D-RR	283D-FB19D-25D-RR	283D-FB19B-25D-RR

NEMA Type 4X with quick disconnects for ArmorConnect power media, Up to 480V AC

Current Rating [A]	kW		Hp			24V DC Control Voltage	120V AC Control Voltage	240V AC Control Voltage
	230V AC 50 Hz	380/ 400/ 415V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	Cat. No.	Cat. No.	Cat. No.
1.1…3.0	0.55	1.1	0.5	0.5	1.5	283D-SB3Z-10A-RR	283D-SB3D-10A-RR	283D-SB3B-10A-RR
3.0…5.5	1.1	2.2	1	1	3	283D-SB9Z-10B-RR	283D-SB9D-10B-RR	283D-SB9B-10B-RR
5.3…7.6	1.5	3	1.5	2	5	283D-SB16Z-10C-RR	283D-SB16D-10C-RR	283D-SB16B-10C-RR
6.3…16	4	5.5	3	5	10	283D-SB19Z-25D-RR	283D-SB19D-25D-RR	283D-SB19B-25D-RR

IP67/NEMA Type 4 with conduit entrance, Up to 575V AC

Current Rating [A]	kW		Hp				24V DC Control Voltage	120V AC Control Voltage	240V AC Control Voltage
	230V AC 50 Hz	400V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	575V AC 60 Hz	Cat. No.	Cat. No.	Cat. No.
1.1…3.0	0.55	1.1	0.5	0.5	1.5	2	283D-FC3Z-10A-CR	283D-FC3D-10A-CR	283D-FC3B-10A-CR
3.0…5.5	1.1	2.2	1	1	3	3	283D-FC9Z-10B-CR	283D-FC9D-10B-CR	283D-FC9B-10B-CR
5.3…7.6	1.5	3	1.5	2	5	5	283D-FC16Z-10C-CR	283D-FC16D-10C-CR	283D-FC16B-10C-CR
6.3…16	4	5.5	3	5	10	10	283D-FC19Z-25D-CR	283D-FC19D-25D-CR	283D-FC19B-25D-CR

IP67/NEMA Type 4 with quick disconnects for ArmorConnect power media, Up to 575V AC

Current Rating [A]	kW		Hp				24V DC Control Voltage	120V AC Control Voltage	240V AC Control Voltage
	230V AC 50 Hz	400V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	575V AC 60 Hz	Cat. No.	Cat. No.	Cat. No.
1.1…3.0	0.55	1.1	0.5	0.5	1.5	2	283D-FC3Z-10A-RR	283D-FC3D-10A-RR	283D-FC3B-10A-RR
3.0…5.5	1.1	2.2	1	1	3	3	283D-FC9Z-10B-RR	283D-FC9D-10B-RR	283D-FC9B-10B-RR
5.3…7.6	1.5	3	1.5	2	5	5	283D-FC16Z-10C-RR	283D-FC16D-10C-RR	283D-FC16B-10C-RR
6.3…16	4	5.5	3	5	10	10	283D-FC19Z-25D-RR	283D-FC19D-25D-RR	283D-FC19B-25D-RR

NEMA Type 4X with conduit entrance, Up to 575V AC

Current Rating [A]	kW		Hp				24V DC Control Voltage	120V AC Control Voltage	240V AC Control Voltage
	230V AC 50 Hz	400V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	575V AC 60 Hz	Cat. No.	Cat. No.	Cat. No.
1.1…3.0	0.55	1.1	0.5	0.5	1.5	2	283D-SC3Z-10A-CR	283D-SC3D-10A-CR	283D-SC3B-10A-CR
3.0…5.5	1.1	2.2	1	1	3	3	283D-SC9Z-10B-CR	283D-SC9D-10B-CR	283D-SC9B-10B-CR
5.3…7.6	1.5	3	1.5	2	5	5	283D-SC16Z-10C-CR	283D-SC16D-10C-CR	283D-SC16B-10C-CR
6.3…16	4	5.5	3	5	10	10	283D-SC19Z-25D-CR	283D-SC19D-25D-CR	283D-SC19B-25D-CR

NEMA Type 4X with quick disconnects for ArmorConnect power media, Up to 575V AC

Current Rating [A]	kW		Hp				24V DC Control Voltage	120V AC Control Voltage	240V AC Control Voltage
	230V AC 50 Hz	400V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	575V AC 60 Hz	Cat. No.	Cat. No.	Cat. No.
1.1…3.0	0.55	1.1	0.5	0.5	1.5	2	283D-SC3Z-10A-RR	283D-SC3D-10A-RR	283D-SC3B-10A-RR
3.0…5.5	1.1	2.2	1	1	3	3	283D-SC9Z-10B-RR	283D-SC9D-10B-RR	283D-SC9B-10B-RR
5.3…7.6	1.5	3	1.5	2	5	5	283D-SC16Z-10C-RR	283D-SC16D-10C-RR	283D-SC16B-10C-RR
6.3…16	4	5.5	3	5	10	10	283D-SC19Z-25D-RR	283D-SC19D-25D-RR	283D-SC19B-25D-RR

ArmorPoint Bus Network Communication

IP67/NEMA Type 4 with conduit entrance, Up to 480V AC

Current Rating [A]	kW		Hp			24V DC Control Voltage	120V AC Control Voltage	240V AC Control Voltage
	230V AC 50 Hz	380/ 400/ 415V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	Cat. No.	Cat. No.	Cat. No.
1.1…3.0	0.37	1.1	0.5	0.5	1.5	283A-FB3Z-10A-CR	283A-FB3D-10A-CR	283A-FB3B-10A-CR
3.0…5.5	1.5	2.2	1	1	3	283A-FB9Z-10B-CR	283A-FB9D-10B-CR	283A-FB9B-10B-CR
5.3…7.6	3	3	1.5	2	5	283A-FB16Z-10C-CR	283A-FB16D-10C-CR	283A-FB16B-10C-CR
6.3…16	4	5.5	3	5	10	283A-FB19Z-25D-CR	283A-FB19D-25D-CR	283A-FB19B-25D-CR

IP67/NEMA Type 4 with quick disconnects for ArmorConnect power media, Up to 480V AC

Current Rating [A]	kW		Hp			24V DC Control Voltage	120V AC Control Voltage	240V AC Control Voltage
	230V AC 50 Hz	380/ 400/ 415V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	Cat. No.	Cat. No.	Cat. No.
1.1…3.0	0.55	1.1	0.5	0.5	1.5	283A-FB3Z-10A-RR	283A-FB3D-10A-RR	283A-FB3B-10A-RR
3.0…5.5	1.1	2.2	1	1	3	283A-FB9Z-10B-RR	283A-FB9D-10B-RR	283A-FB9B-10B-RR
5.3…7.6	1.5	3	1.5	2	5	283A-FB16Z-10C-RR	283A-FB16D-10C-RR	283A-FB16B-10C-RR
6.3…16	4	5.5	3	5	10	283A-FB19Z-25D-RR	283A-FB19D-25D-RR	283A-FB19B-25D-RR

IP67/NEMA Type 4 with conduit entrance, Up to 575V AC

Current Rating [A]	kW		Hp				24V DC Control Voltage	120V AC Control Voltage	240V AC Control Voltage
	230V AC 50 Hz	400V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	575V AC 60 Hz	Cat. No.	Cat. No.	Cat. No.
1.1…3.0	0.55	1.1	0.5	0.5	1.5	2	283A-FC3Z-10A-CR	283A-FC3D-10A-CR	283A-FC3B-10A-CR
3.0…5.5	1.1	2.2	1	1	3	3	283A-FC9Z-10B-CR	283A-FC9D-10B-CR	283A-FC9B-10B-CR
5.3…7.6	1.5	3	1.5	2	5	5	283A-FC16Z-10C-CR	283A-FC16B-10C-CR	283A-FC16B-10C-CR
6.3…16	4	5.5	3	5	10	10	283A-FC19Z-25D-CR	283A-FC19D-25D-CR	283A-FC19B-25D-CR

IP67/NEMA Type 4 with quick disconnects for ArmorConnect power media, Up to 575V AC

Current Rating [A]	kW		Hp				24V DC Control Voltage	120V AC Control Voltage	240V AC Control Voltage
	230V AC 50 Hz	400V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	575V AC 60 Hz	Cat. No.	Cat. No.	Cat. No.
1.1…3.0	0.55	1.1	0.5	0.5	1.5	2	283A-FC3Z-10A-RR	283A-FC3D-10A-RR	283A-FC3B-10A-RR
3.0…5.5	1.1	2.2	1	1	3	3	283A-FC9Z-10B-RR	283A-FC9D-10B-RR	283A-FC9B-10B-RR
5.3…7.6	1.5	3	1.5	2	5	5	283A-FC16Z-10C-RR	283A-FC16B-10C-RR	283A-FC16B-10C-RR
6.3…16	4	5.5	3	5	10	10	283A-FC19Z-25D-RR	283A-FC19D-25D-RR	283A-FC19B-25D-RR

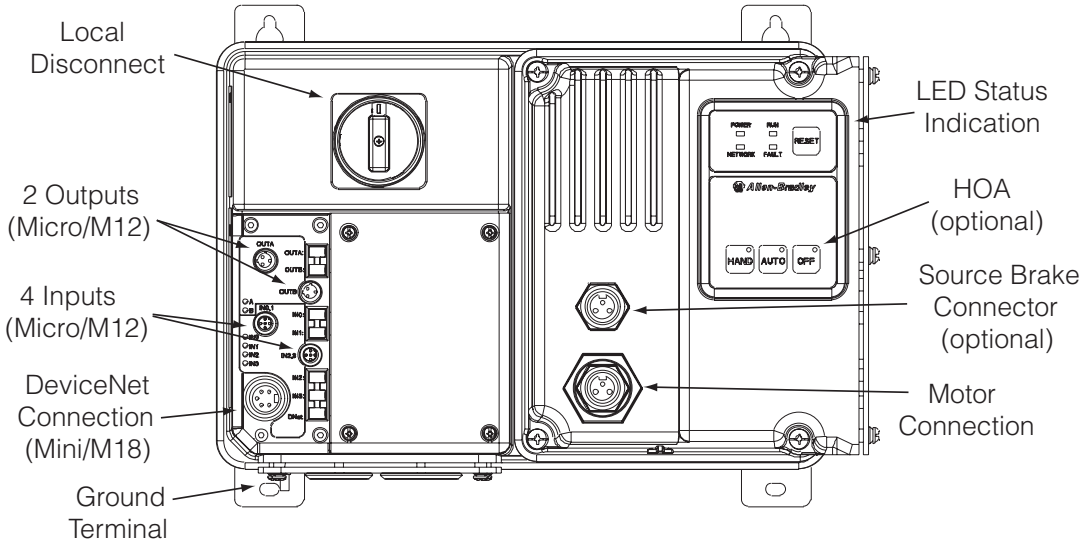
Options – Factory Installed

	Description	Cat. No. Modification
	Hand/Off/Auto Selector Keypad	-3
	Safety Monitor❄	-SM
	Supplied ArmorStart without motor cable	-CRW
	Supplied ArmorStart with source brake cable	-SB
	Supplied ArmorStart without source brake cable	-SBW
	ArmorConnect Power Media Connectivity, ArmorStart supplied without motor cable	-RRW

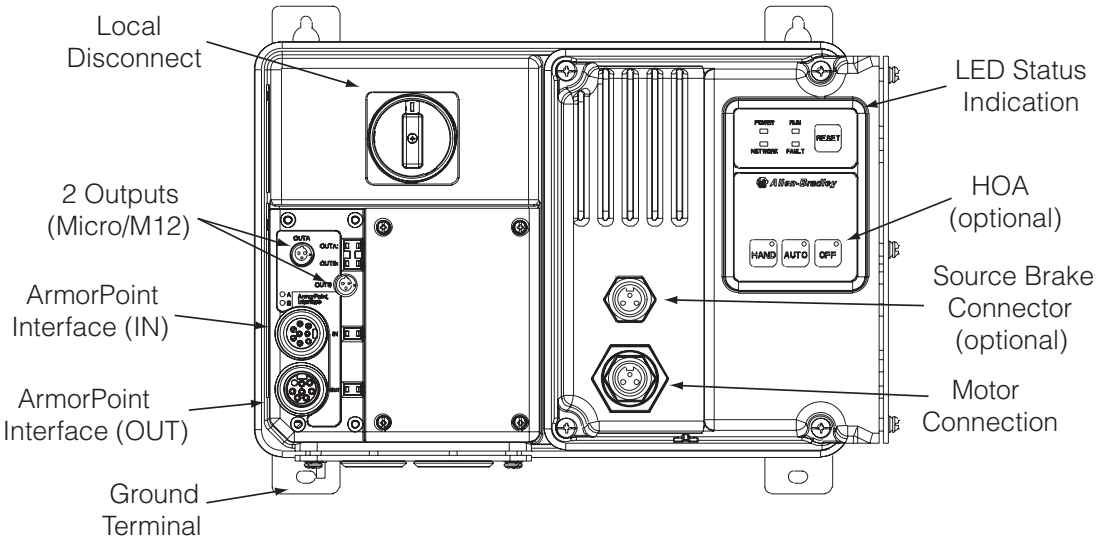
❄ Not available with round media option (RR).

Connections

Bulletin 283D ArmorStart with DeviceNet Communications



Bulletin 283A ArmorStart for the ArmorPoint Backplane



ArmorStart Receptacle Pin Outs

Receptacle Connections for ArmorPoint Interface (OUT)

Pin 1: CAN high
Pin 2: Common
Pin 3: +5V
Pin 4: CAN low
Pin 5: Enable out
Pin 7: Common
Pin 8: NC (no connection)

Receptacle Connections for ArmorPoint Interface (IN)

Pin 1: CAN high
Pin 2: Common
Pin 3: +5V
Pin 4: CAN low
Pin 5: Enable out
Pin 7: Common
Pin 8: PE

Receptacle Connections for DeviceNet Connector

Pin 1: Drain (no connection)
Pin 2: +VDNET
Pin 3: -VDNET
Pin 4: CAN_H
Pin 5: CAN_L

Receptacle Connections for Input (M12)

Pin 1: +24V (A3 or DNET)
Pin 2: Input 0
Pin 3: Common
Pin 4: Input 1
Pin 5: NC (no connection)

Receptacle Connections for Output, DeviceNet or ArmorPoint Version (M12)

Pin 1: PE
Pin 2: Return
Pin 3: Relay out

Receptacle Connections for Incoming Control Power

Pin 1: Unswitched (A3)(red)
Pin 2: Common (A2)(black)
Pin 3: PE (green)
Pin 4: Not used (blank)
Pin 5: Switched (A1)(blue)
Pin 6: Not used (white)

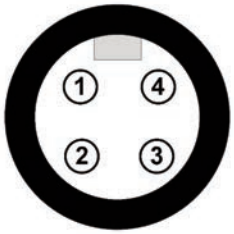
Receptacle Connections for Source Brake

Pin 1: L1 (black)
Pin 2: GND (green/yellow)
Pin 3: L2 (white)

Receptacle Connections for Motor Connector - 5 Hp or less (M22)

Pin 1: T1 (black)
Pin 2: T2 (white)
Pin 3: T3 (red)
Pin 4: Ground (green/yellow)

Receptacle Connections for Motor Connector - 10 Hp (M35)



Pin 1: T1 (black)
Pin 2: Ground (green/yellow)
Pin 3: T3 (red)
Pin 4: T2 (white)

ArmorStart Receptacle Pin Outs, Continued

Receptacle Connections for Incoming 3-phase Power - 10 A Short Circuit Protection (M22)

Pin 1: L1 (black)
Pin 2: L2 (white)
Pin 3: L3 (red)
Pin 4: Ground (green/yellow)

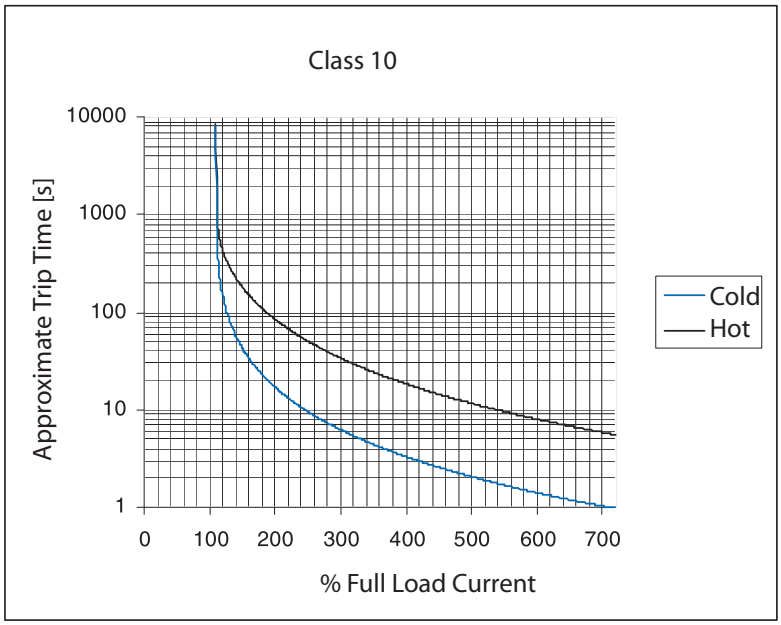
Receptacle Connections for Incoming 3-phase Power - 25 A Short Circuit Protection (M35)

Pin 1: L1 (black)
Pin 2: Ground (green/yellow)
Pin 3: L3 (red)
Pin 4: L2 (white)

4

Motor Overload Trip Curves

Motor overload current parameter provides class 10 overload protection. Ambient insensitivity is inherent in the electronic design of the overload.



Electrical Ratings		UL/NEMA	IEC
Power Circuit	Rated Operation Voltage	200…575Y	200…575V
	Rate Insulation Voltage	600V	500V
	Rated Impulsed Voltage	6 kV	6 kV
	Dielectric Withstand	2200V AC	2500V AC
	Operating Frequency	50/60 Hz	50/60 Hz
	Utilization Category	N/A	AC-3
	Protection Against Shock	N/A	IP2X
	Rated Operating Current Max.	280_-___-10A-*	3.0 A
		280_-___-10B-*	5.5 A
		280_-___-10C-*	7.6 A
		280_-___-10D-*	16 A
Control Circuit	Rated Operation Voltage	24V DC (+10%, -15%) A2 (should be grounded at voltage source)	
		120V AC (+10%, -15%) A2 (should be grounded at voltage source)	
		240V AC (+10%, -15%) A2 (should be grounded at voltage source)	
	Rated Insulation Voltage	250V	250V
	Rated Impulsed Voltage	—	4 kV
	Dielectric Withstand	1500V AC	2000V AC
	Overvoltage Category	—	III
	Operating Frequency	50/60 Hz	

Short Circuit Protection	SCPD Performance Type 1	**Current Rating**	**Voltage**	480Y/277V	480Y/480V	600Y/347V	600V
		1.1…3.0 A	Sym. Amps RMS	65 kA	65 kA	30 kA	30 kA
		3.0…5.5 A					
		5.3…7.6 A					
		6.3…16 A		30 kA	30 kA	30 kA	30 kA
	SCPD List	Size per NFPA 70 (NEC) or NFPA 79 for Group Motor Applications					

Power Requirements				
	Units			
Control Voltage (Nom)	Volts	24V DC	120V AC	240V AC
Power supply (Nom)	Amps	0.170	0.110	0.060
Total Control Power (Starting/Stopping)	VA (W)	(90 W)	35	35
Total Control Power (Running)	VA (W)	(8 W)	28	28
External Devices powered by Control Voltage				
Outputs (2) (1 A max. each)	Amps	2	2	2
Total Control (Pick Up) with max outputs	VA (W)	(138 W)	275	515
Total Control (Hold In) with max outputs	VA (W)	(56 W)	268	508

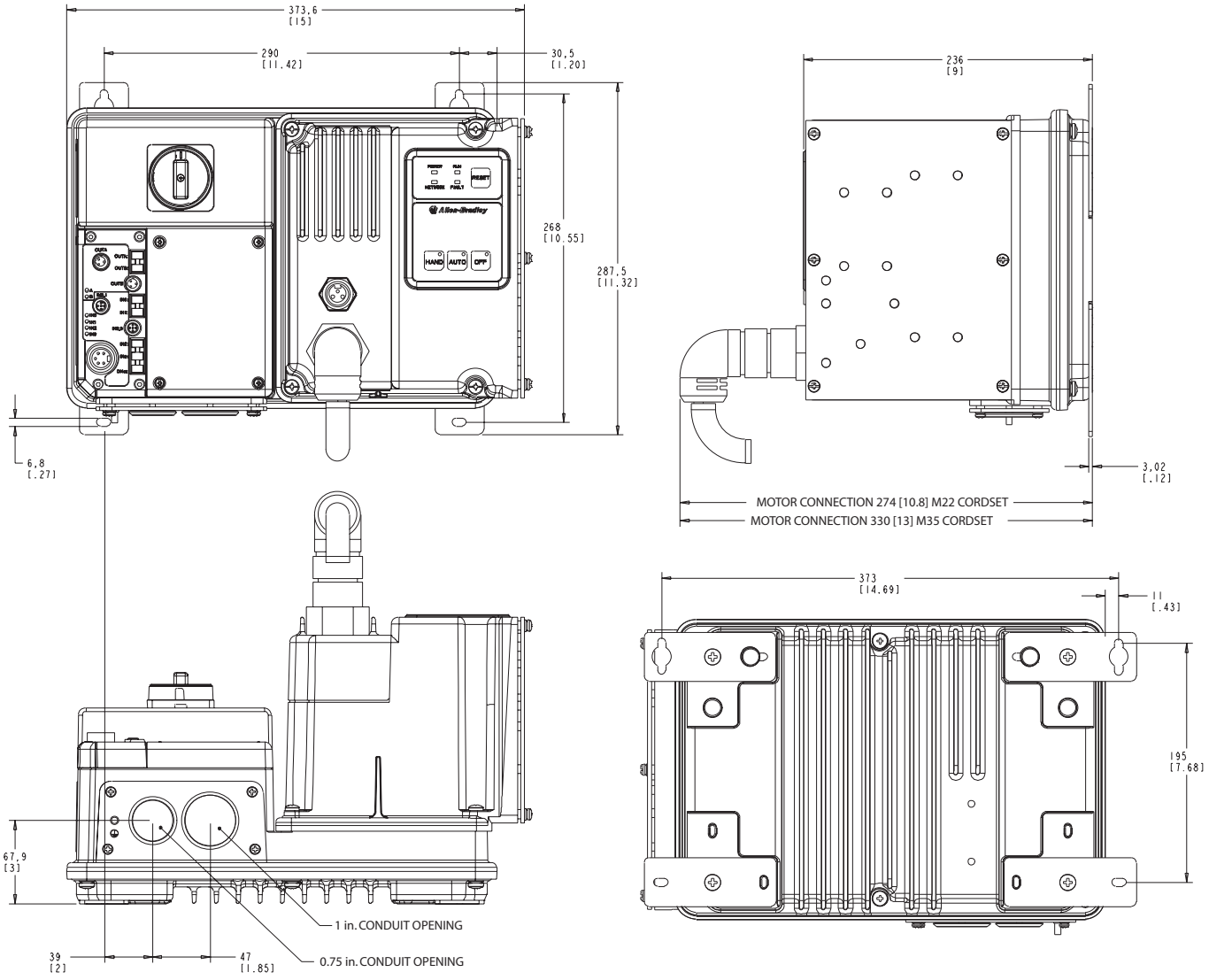
Input Ratings	Rated Operation Voltage	24V DC	
	Rated Insulation Voltage	1500V AC	
	Input On-State Voltage Range	10…26V DC	
	Input On-State Current	3.0 mA @ 10V DC	
		7.2 mA @ 24V DC	
	Input Off-State Voltage Range	0…5V DC	
	Input Off-State Current	<1.5 mA	
	Input Filter — Software Selectable		
	Off to On	Settable from 0…64 ms in 1 ms increments	
	On to Off	Settable from 0…64 ms in 1 ms increments	
	Input Compatibility	N/A	IEC 1+
	Number of Inputs	4	
	Sensor Source		
	Voltage Status Only	11…25V DC from DeviceNet	
	Current Available	50 mA max. per input, 200 mA total	

Output Ratings (Sourced from Control Circuit)	Rated Operation Voltage	250V AC/30V DC	250V AC/30V DC
	Rated Insulation Voltage	250V	250V
	Dielectric Withstand	1500V AC	2000V AC
	Operating Frequency	50/60 Hz	50/60 Hz
	Type of Control Circuit	Electromechanical relay	
	Type of Current	AC/DC	
	Conventional Thermal Current Ith	Total of both outputs ≤ 2 A	
	Type of Contacts	Normally open (N.O.)	
	Number of Contacts	2	

		UL/NEMA	IEC
Environmental	Operating Temperature Range	-20…+40 °C (-4…+104 °F)	
	Storage and Transportation temperature range	–25….+85 °C (–13…+185 °F)	
	Altitude	2000 m	
	Humidity	5…95% (non-condensing)	
	Pollution Degree	3	
	Enclosure Ratings	NEMA 4/12/13	IP67
	Enclosure Ratings	NEMA 4X	IP69K
	Approximate Shipping Weight	16.8 kg (37 lb)	
Mechanical	**Resistance to Shock**		
	Operational	15 G	
	Non-Operational	30 G	
	Resistance to Vibration		
	Operational	1 G, 0.15 mm (0.006 in.) displacement	
	Non-Operational	2.5 G, 0.38 mm (0.015 in.) displacement	
	Power and Ground Terminals		
	Wire Size	Primary/Secondary terminal: (#16 …#10 AWG)	Primary/Secondary terminal: 1.5…4.0 mm^2
	Tightening Torque	Primary terminal: 10.8 lb•in Secondary terminal: 4.5 lb•in	Primary terminal: (1.2 N•m) Secondary terminal: (0.5 N•m)
	Wire Strip Length	0.35 in. (9 mm)	
	Control and Safety Monitor Inputs		
	Wire Size	(18…10 AWG)	1.0…4.0 mm^2
	Tightening Torque	6.2 lb•in	0.7 N•m
	Wire Strip Length	0.35 in. (9 mm)	
	Disconnect Lock Out	Maximum of 5/16 in. (8 mm) lock shackle or hasp. The hasp should not exceed 5/16 in. (8 mm) when closed, or damage will occur to disconnect guard.	
Other Rating	**EMC Emission Levels**		
	Conducted Radio Frequency Emissions	Class A	
	Radiated Emissions	Class A	
	EMC Immunity Levels		
	Electrostatic Discharge	4 kV contact and 8 kV Air	
	Radio Frequency Electromagnetic Field	10V/m	
	Fast Transient	2 kV	
	Surge Transient	1 kV (12) $_{L-L}$, 2 kV (2) $_{L-N}$ (earth)	
	Overload Characteristics		
	Overload Current Range	1.1…3.0 A	
		3.0…5.5 A	
		5.3…7.6 A	
		6.3…16 A	
	Trip Class	10	
	Trip Rating	120% of FLC setting	
	Number of Poles	3	
	DeviceNet Specifications		
	DeviceNet Supply Voltage Rating	Range 11…25V DC, 24V DC nominal	
	DeviceNet Input Current	167 mA @ 24V DC - 4.0 W	
		364 mA @ 11V DC - 4.0 W	
	External Devices powered by DeviceNet	Sensors inputs 4 x 50 mA - total 200 mA	
	Total w/max Sensor Inputs (4)	367 mA @ 24V DC - 8.8 W	
	DeviceNet Input Current Surge	15 A for 250 µs	
	DeviceNet Communications		
	Baud Rates	125, 250, 500 kbps	
	Distance Maximum	500 m (1630 ft) @ 125 kbps	
		200 m (656 ft) @ 250 kbps	
		100 m (328 ft) @ 500 kbps	
	ArmorPoint Backplane Current Load	400 mA	
Standards Compliance		UL 508; CSA C22.2, No. 14; EN/IEC 60947; EN/IEC 60947-1; CE Marked per Low Voltage Directive 2006/95/EC and EMC Directive 2004/108/EC; CCC; ODVA for DeviceNet	
Certifications		cULus (File No. E96956, Guides NMFT, NMFT7)	

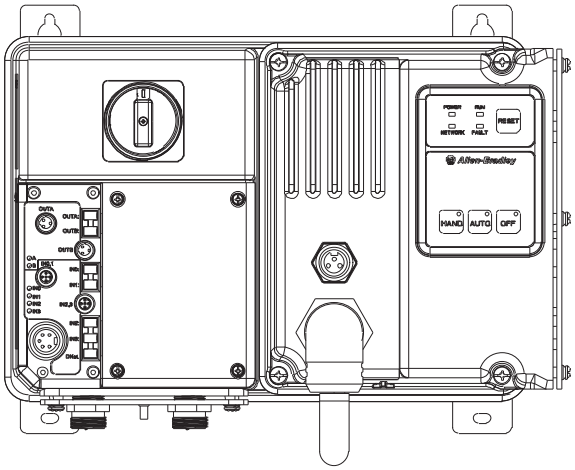
Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.

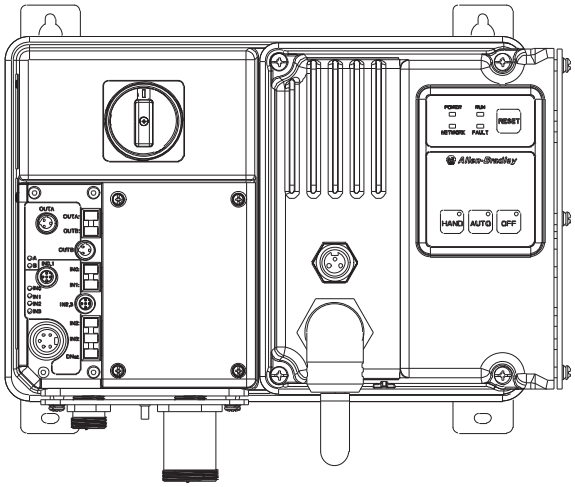
Dimensions for IP67/NEMA Type 4 with Conduit Entrance

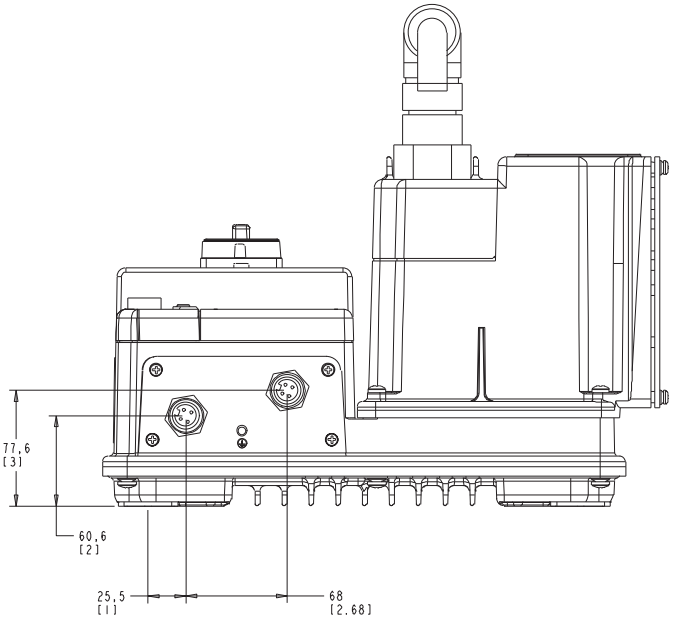


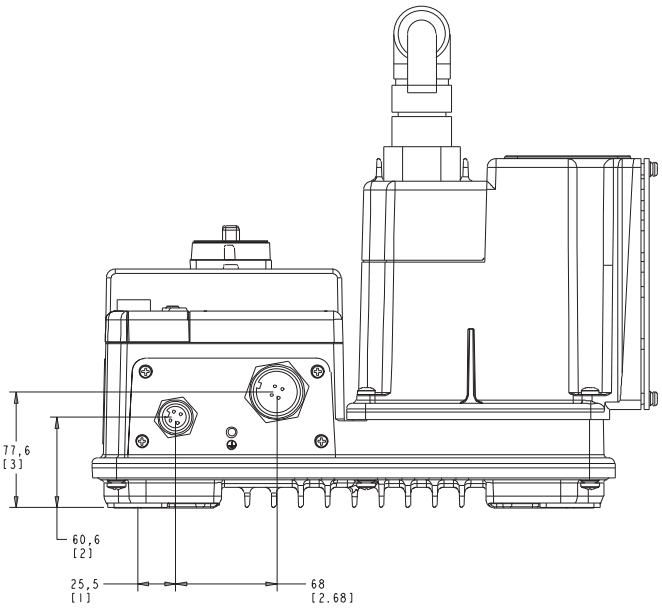
Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.

Dimensions for IP67/NEMA Type 4 with ArmorConnect Connectivity





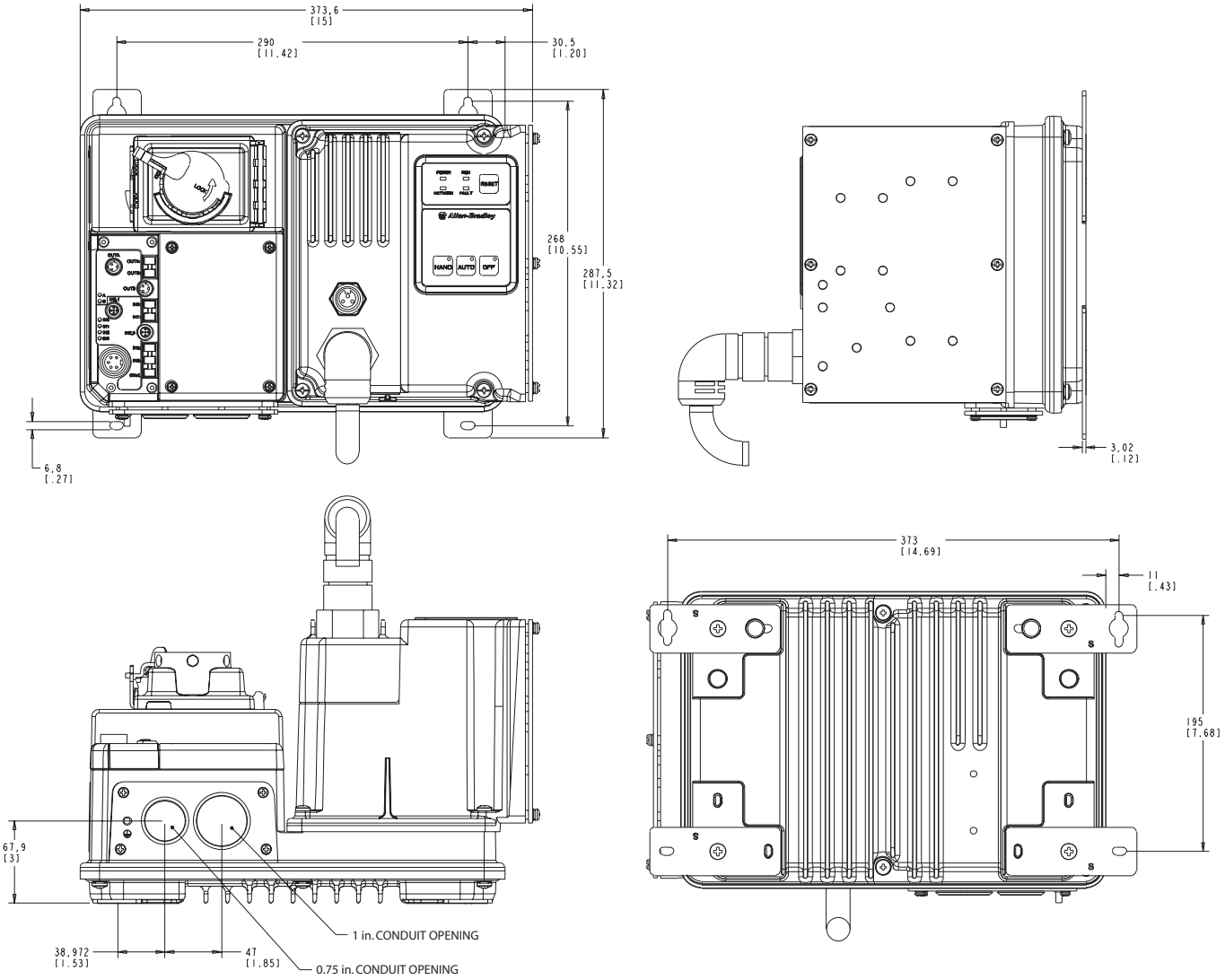




Approximate Dimensions

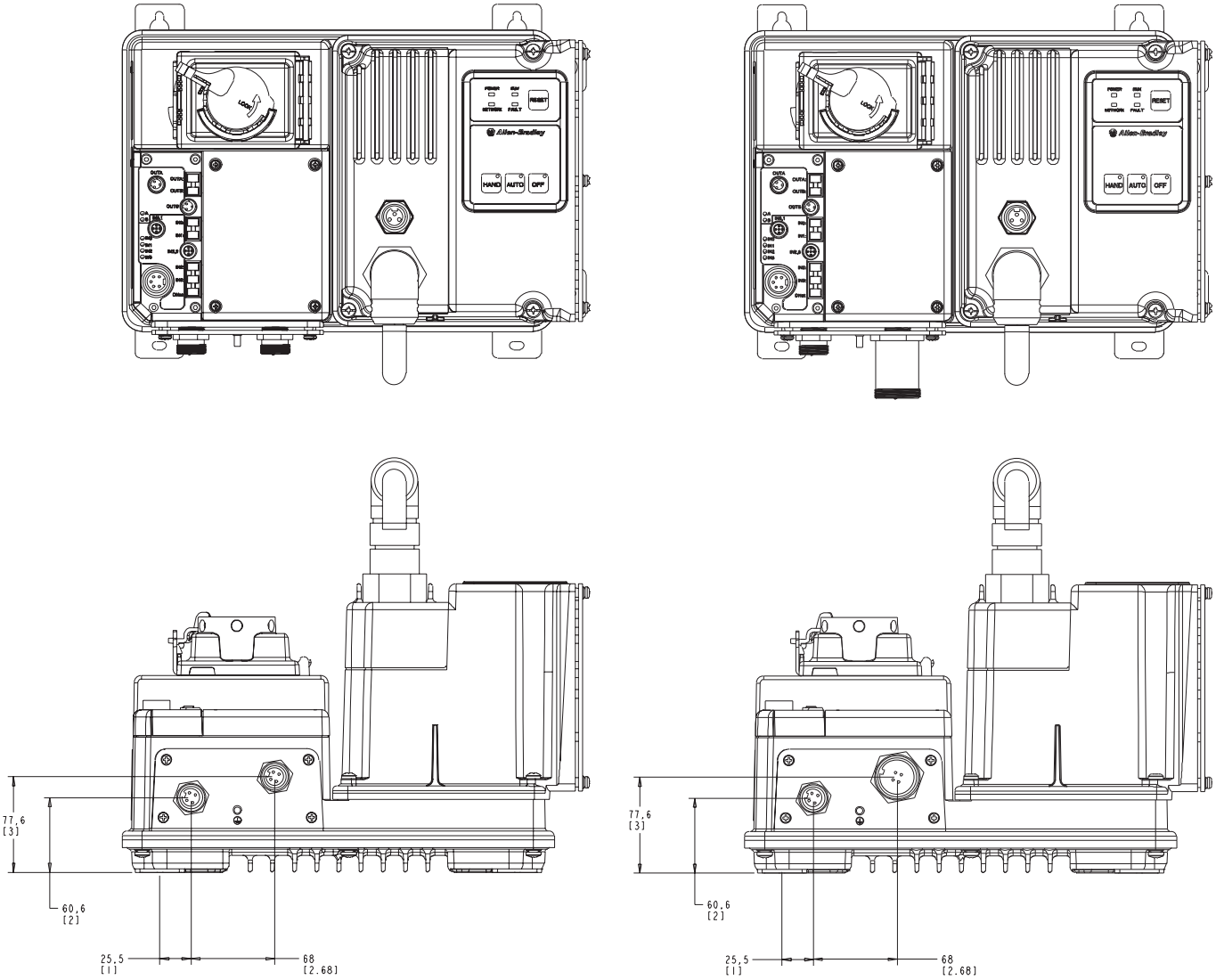
Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.

Dimensions for NEMA Type 4X with Conduit Entrance



Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.

Dimensions for NEMA Type 4X with ArmorConnect Connectivity



Bulletin 284 ArmorStart Distributed Motor Controller

- On-Machine starting solution
- Variable frequency AC drive using PowerFlex® technology
- Horsepower range 0.5…5 Hp (0.4…3.3 kW)
- Robust IP67/NEMA Type 4 or NEMA Type 4X enclosure rating
- Quick disconnect for I/O, communications, motor, three-phase, and control power connections
- LED status indication
- EtherNet/IP, DeviceNet, and ControlNet communications
- Local logic control via DeviceLogix
- Peer-to-peer communications (ZIP) (not available with EtherNet/IP communications)
- Connectivity to ArmorPoint distributed I/O products
- Factory installed options:
  - EMI filter
  - Dynamic brake connector
  - Output contactor
  - 0…10V analog input
  - Hand/Off/Auto (HOA) with jog
  - Control brake contactor
  - Source brake contactor
  - Shielded motor cable
  - Safety monitor

Table of Contents

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Specifications 4-46
Approximate Dimensions 4-51

Standards Compliance

UL 508C
CSA C22.2, No. 14
EN/IEC 60947-4-2, EN 50178, EN 61800-3
CE Marked per Low Voltage Directive 2006/95/EC and EMC Directive 2004/108/EC
CCC
ODVA for EtherNet/IP and DeviceNet

Certifications

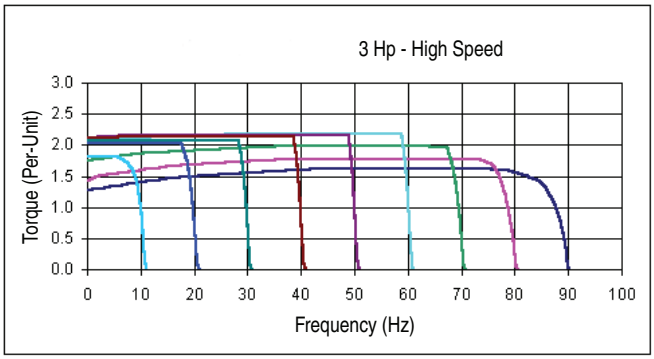
cULus (File No. E207834, Guide NMMS, NMMS7)

4

Mode of Operation

Sensorless Vector Performance (SVP) - V/Hz

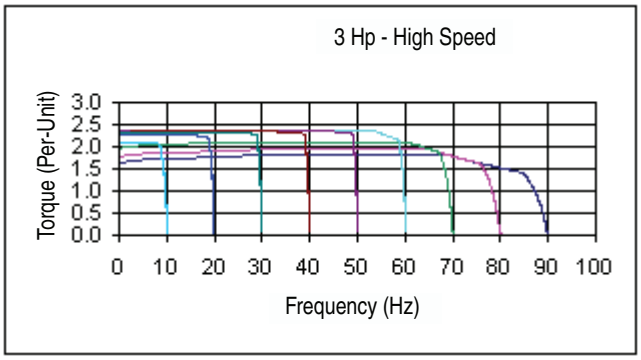
This method provides excellent speed regulation and high levels of torque across the entire speed range of the drive, and improved speed regulation even as loading increases. Basic control yields the most cost-effective performance when sensorless vector control is not required.



- Automatically provides auto boost (IR compensation) and slip compensation.

Sensorless Vector Control (SVC)

Sensorless vector control provides exceptional speed regulation and very high levels of torque across the entire speed range of the drive.



- The Autotune feature allows the Bulletin 284 (SVC) to adapt to individual motor characteristics.
- Timer, Counter, Basic Logic and StepLogic™ functions can reduce hardware design costs and simplify control schemes.
- Develops high torque over a wide speed range and adapts to individual motor characteristics.

Overload Protection

The Bulletin 284 ArmorStart Distributed Motor Controller incorporates, as standard, electronic motor overload protection. This overload protection is accomplished electronically with an I^2t algorithm. The ArmorStart's overload protection is programmable via the communication network providing the user with flexibility. The overload trip class allows for class 10 overload protection. Ambient insensitivity is inherent in the electronic design of the overload.

Local Logic via DeviceLogix

Provides local control over the device's discrete and network I/O. DeviceLogix consists of function blocks, inputs, outputs, and actual hardware data, including fault and status bits.

Fault Diagnostics

Fault diagnostics capabilities built into the Bulletin 284 ArmorStart Distributed Motor Controller help you pinpoint a problem for easy troubleshooting and quick re-starting.

- Short Circuit
- Overload
- Phase Short
- Ground Fault
- Stall
- Control Power Loss
- Control Power Fuse Protection
- I/O Fault
- Overcurrent
- Brake Fuse Protection
- Overtemperature
- Output Fuse Protection
- DeviceNet Power Loss
- Internal Communication Fault
- DC Bus Fault
- EEPROM Fault
- Hardware Fault
- Restart Retries
- Miscellaneous Fault

Factory-Installed Options

HOA Selector Keypad with Jog Function

The HOA Selector Keypad with Jog Function allows for local start/stop control with capabilities to JOG and to Forward/Reverse motor direction.

EMI Filter

The EMI Filter is required to be CE compliant. When selected, a 3–meter shielded 4–conductor motor cordset is provided as standard. This is only available with sensorless vector control.

Control Brake Connector

An internal contactor is used to switch an electromechanical motor brake On/Off. The motor brake is powered from the control power circuit. The configuration of the R1 relay controls the function of the brake. A customer accessible 3 A fuse is provided to protect the brake cable. Included is a 3-meter 3-pin cordset for connection to the motor brake as standard.

Source Brake Contactor

An internal contactor is used to switch an electromechanical motor brake On/Off. The motor brake is powered from the line power circuit. The configuration of the R1 relay controls the function of the brake. A customer accessible 3 A fuse is provided to protect the brake cable. Included is a 3-meter 3-pin cordset for connection to the motor brake as standard.

Shielded Motor Cable

A 3-meter shielded 4-conductor cordset is provided instead of the 3-meter unshielded 4-conductor cordset, when the EMI Filter is selected.

Dynamic Brake Connector

This includes a 3-meter, 3-pin cordset for connection to a IP20 dynamic brake module. See Accessories on page 4-84 for available modules.

IP67 Dynamic Brake Connector

The IP67 Dynamic Brake Resistor design offers simplicity in wiring and installation. The DB1 option must be selected in order to have the quick disconnect connectivity. See accessories for available IP67 Dynamic Brake Resistors.

Output Contactor

An internal contactor is sourced from control voltage to isolate the load side of the VFD. Control voltage or the at-motor disconnect controls the ON/OFF of the output contactor. A sequenced stop involving the output contact cannot be performed.

Safety Monitor

The Safety Monitor Option allows for independent monitoring of the output contactor status. The output contactor is provided as standard with this option. The function is implemented using the normally closed auxiliary contact which complies with IEC 60947-5-1 for mechanically linked contacts. Two terminal blocks are provided as inputs to an external device, such as a safety circuit.

0…10V Analog Input Connector

This provides 0…10V analog input as an external frequency command from the analog input or remote potentiometer. A 5-pin micro receptacle is provided for connectivity. A shielded 5-conductor cordset or patch cord is recommended.

Sensorless Vector Performance (SVP), typical of Powerflex 4 Class Drive

Examples given in this section are for reference purposes. This basic explanation should not be used for product selection; not all combinations will produce a valid catalog number.

284	D	–	F	H	D2P3	D	–	10	–	CR	–	Option 1	–	Option 2	–	Option 3
a	*b*		*c*	*d*	*e*	*f*		*g*		*h*		*i*		*j*		*k*

a

Bulletin Number	
Code	Description
284	VFD Starter

b

Communications	
Code	Description
D	DeviceNet
A	ArmorPoint

c

Enclosure Type	
Code	Description
F	Type 4 (IP67)
S	Type 4X

d

Torque Performance Mode	
Code	Description
H	Volts per Hertz (Sensorless Vector Performance)

e

Output Current			
200…240V		380…480V	
Code	Description	Code	Description
B2P3	2.3 A, 0.4 kW, 0.5 Hp	D1P4	1.4 A, 0.4 kW, 0.5 Hp
B4P5	4.5 A, 0.75 kW, 1.0 Hp	D2P3	2.3 A, 0.75 kW, 1.0 Hp
B7P6	7.6 A, 1.5 kW, 2.0 Hp	D4P0	4.0 A, 1.5 kW, 2.0 Hp
—	—	D6P0	6.0 A, 2.2 kW, 3.0 Hp
—	—	D7P6	7.6 A, 3.3 kW, 5.0 Hp

f

Control Voltage	
Code	Description
Z	24V DC
D	120V AC
B	240V AC

g

Short Circuit Protection (Motor Circuit Protector)	
Code	Description
10	10 A Rated Device
25	25 A Rated Device

i

Option 1	
Code	Description
3	Hand/Off/Auto Selector Keypad with Jog Function

j

Option 2		
Code		Description
CB	blank	Control Brake Contactor
CB	W ∗	No cable
DB	blank	DB Brake Connector
DB1	blank	Connectivity to IP67 DB Resistor
SB	blank	Source Brake Contactor
SB	W ∗	No cable

k

Option 3	
Code	Description
OC	Output Contactor
SM ❄‡	Safety Monitor

h

Control and 3-Phase Power Connections / Motor Cable Connection (CR: Conduit/Round Media) or (RR: Round/Round Media)				
Code		Description		
		Control Power	3-Phase Power	Motor Cable
CR	blank	Conduit Entrance	Conduit Entrance	3 m, unshielded cordset male 90°
CR	N	Conduit Entrance	Conduit Entrance	3 m, shielded cordset male 90°
CR	W ∗	Conduit Entrance	Conduit Entrance	No cable
RR	blank	Round Media (Male Receptacle)	Round Media (Male Receptacle)	3 m, unshielded cordset male 90°
RR	N	Round Media (Male Receptacle)	Round Media (Male Receptacle)	3 m, shielded cordset male 90°
RR	W ∗	Round Media (Male Receptacle)	Round Media (Male Receptacle)	No cable

∗ See Accessories on page 4-82 for extended motor and brake cable lengths.
❄ The output contactor is included with the Safety Monitor option.
‡ Not available with round media option (RR).

DeviceNet Network Communication

IP67/NEMA Type 4 with conduit entrance, Volts per Hertz (SVP) torque performance, Up to 480V AC

Input Voltage	3-Phase kW Rating	3-Phase Hp Rating	Output Current [A]	24V DC Control Voltage Cat. No.	120V AC Control Voltage Cat. No.	240V AC Control Voltage Cat. No.
200...240V, 50/60 Hz 3-Phase	0.4	0.5	2.3	284D-FHB2P3Z-10-CR	284D-FHB2P3D-10-CR	284D-FHB2P3B-10-CR
	0.75	1	4.5	284D-FHB4P5Z-10-CR	284D-FHB4P5D-10-CR	284D-FHB4P5B-10-CR
	1.5	2	7.6	284D-FHB7P6Z-25-CR	284D-FHB7P6D-25-CR	284D-FHB7P6B-25-CR
380...480V, 50/60 Hz 3-Phase	0.4	0.5	1.4	284D-FHD1P4Z-10-CR	284D-FHD1P4D-10-CR	284D-FHD1P4B-10-CR
	0.75	1	2.3	284D-FHD2P3Z-10-CR	284D-FHD2P3D-10-CR	284D-FHD2P3B-10-CR
	1.5	2	4	284D-FHD4P0Z-10-CR	284D-FHD4P0D-10-CR	284D-FHD4P0B-10-CR
	2.2	3	6	284D-FHD6P0Z-25-CR	284D-FHD6P0D-25-CR	284D-FHD6P0B-25-CR
	3	5	7.6	284D-FHD7P6Z-25-CR	284D-FHD7P6D-25-CR	284D-FHD7P6B-25-CR

IP67/NEMA Type 4 with quick disconnects for ArmorConnect power media, Volts per Hertz (SVP) torque performance, Up to 480V AC

Input Voltage	3-Phase kW Rating	3-Phase Hp Rating	Output Current [A]	24V DC Control Voltage Cat. No.	120V AC Control Voltage Cat. No.	240V AC Control Voltage Cat. No.
200…240V, 50/60 Hz 3-Phase	0.4	0.5	2.3	284D-FHB2P3Z-10-RR	284D-FHB2P3D-10-RR	284D-FHB2P3B-10-RR
	0.75	1	4.5	284D-FHB4P5Z-10-RR	284D-FHB4P5D-10-RR	284D-FHB4P5B-10-RR
	1.5	2	7.6	284D-FHB7P6Z-25-RR	284D-FHB7P6D-25-RR	284D-FHB7P6B-25-RR
380…480V, 50/60 Hz 3-Phase	0.4	0.5	1.4	284D-FHD1P4Z-10-RR	284D-FHD1P4D-10-RR	284D-FHD1P4B-10-RR
	0.75	1	2.3	284D-FHD2P3Z-10-RR	284D-FHD2P3D-10-RR	284D-FHD2P3B-10-RR
	1.5	2	4	284D-FHD4P0Z-10-RR	284D-FHD4P0D-10-RR	284D-FHD4P0B-10-RR
	2.2	3	6	284D-FHD6P0Z-25-RR	284D-FHD6P0D-25-RR	284D-FHD6P0B-25-RR
	3	5	7.6	284D-FHD7P6Z-25-RR	284D-FHD7P6D-25-RR	284D-FHD7P6B-25-RR

NEMA Type 4X with conduit entrance, Volts per Hertz (SVP) torque performance, Up to 480V AC

Input Voltage	3-Phase kW Rating	3-Phase Hp Rating	Output Current [A]	24V DC Control Voltage Cat. No.	120V AC Control Voltage Cat. No.	240V AC Control Voltage Cat. No.
200…240V, 50/60 Hz 3-Phase	0.4	0.5	2.3	284D-SHB2P3Z-10-CR	284D-SHB2P3D-10-CR	284D-SHB2P3B-10-CR
	0.75	1	4.5	284D-SHB4P5Z-10-CR	284D-SHB4P5D-10-CR	284D-SHB4P5B-10-CR
	1.5	2	7.6	284D-SHB7P6Z-25-CR	284D-SHB7P6D-25-CR	284D-SHB7P6B-25-CR
380…480V, 50/60 Hz 3-Phase	0.4	0.5	1.4	284D-SHD1P4Z-10-CR	284D-SHD1P4D-10-CR	284D-SHD1P4B-10-CR
	0.75	1	2.3	284D-SHD2P3Z-10-CR	284D-SHD2P3D-10-CR	284D-SHD2P3B-10-CR
	1.5	2	4	284D-SHD4P0Z-10-CR	284D-SHD4P0D-10-CR	284D-SHD4P0B-10-CR
	2.2	3	6	284D-SHD6P0Z-25-CR	284D-SHD6P0D-25-CR	284D-SHD6P0B-25-CR
	3	5	7.6	284D-SHD7P6Z-25-CR	284D-SHD7P6D-25-CR	284D-SHD7P6B-25-CR

NEMA Type 4X with quick disconnects for ArmorConnect power media, Volts per Hertz (SVP) torque performance, Up to 480V AC

Input Voltage	3-Phase kW Rating	3-Phase Hp Rating	Output Current [A]	24V DC Control Voltage Cat. No.	120V AC Control Voltage Cat. No.	240V AC Control Voltage Cat. No.
200…240V, 50/60 Hz 3-Phase	0.4	0.5	2.3	284D-SHB2P3Z-10-RR	284D-SHB2P3D-10-RR	284D-SHB2P3B-10-RR
	0.75	1	4.5	284D-SHB4P5Z-10-RR	284D-SHB4P5D-10-RR	284D-SHB4P5B-10-RR
	1.5	2	7.6	284D-SHB7P6Z-25-RR	284D-SHB7P6D-25-RR	284D-SHB7P6B-25-RR
380…480V, 50/60 Hz 3-Phase	0.4	0.5	1.4	284D-SHD1P4Z-10-RR	284D-SHD1P4D-10-RR	284D-SHD1P4B-10-RR
	0.75	1	2.3	284D-SHD2P3Z-10-RR	284D-SHD2P3D-10-RR	284D-SHD2P3B-10-RR
	1.5	2	4	284D-SHD4P0Z-10-RR	284D-SHD4P0D-10-RR	284D-SHD4P0B-10-RR
	2.2	3	6	284D-SHD6P0Z-25-RR	284D-SHD6P0D-25-RR	284D-SHD6P0B-25-RR
	3	5	7.6	284D-SHD7P6Z-25-RR	284D-SHD7P6D-25-RR	284D-SHD7P6B-25-RR

ArmorPoint Bus Network Communication

IP67/NEMA Type 4 with conduit entrance, Volts per Hertz (SVP) torque performance, Up to 480V AC

Input Voltage	3-Phase kW Rating	3-Phase Hp Rating	Output Current [A]	24V DC Control Voltage Cat. No.	120V AC Control Voltage Cat. No.	240V AC Control Voltage Cat. No.
200…240V, 50/60 Hz 3-Phase	0.4	0.5	2.3	284A-FHB2P3Z-10-CR	284A-FHB2P3D-10-CR	284A-FHB2P3B-10-CR
	0.75	1	5	284A-FHB4P5Z-10-CR	284A-FHB4P5D-10-CR	284A-FHB4P5B-10-CR
	1.5	2	7.6	284A-FHB7P6Z-25-CR	284A-FHB7P6D-25-CR	284A-FHB7P6B-25-CR
380…480V, 50/60 Hz 3-Phase	0.4	0.5	1.4	284A-FHD1P4Z-10-CR	284A-FHD1P4D-10-CR	284A-FHD1P4B-10-CR
	0.75	1	2.3	284A-FHD2P3Z-10-CR	284A-FHD2P3D-10-CR	284A-FHD2P3B-10-CR
	1.5	2	4	284A-FHD4P0Z-10-CR	284A-FHD4P0D-10-CR	284A-FHD4P0B-10-CR
	2.2	3	6	284A-FHD6P0Z-25-CR	284A-FHD6P0D-25-CR	284A-FHD6P0B-25-CR
	3	5	7.6	284A-FHD7P6Z-25-CR	284A-FHD7P6D-25-CR	284A-FHD7P6B-25-CR

IP67/NEMA Type 4 with quick disconnects for ArmorConnect power media, Volts per Hertz (SVP) torque performance, Up to 480V AC

Input Voltage	3-Phase kW Rating	3-Phase Hp Rating	Output Current [A]	24V DC Control Voltage Cat. No.	120V AC Control Voltage Cat. No.	240V AC Control Voltage Cat. No.
200…240V, 50/60 Hz 3-Phase	0.4	0.5	2.3	284A-FHB2P3Z-10-RR	284A-FHB2P3D-10-RR	284A-FHB2P3B-10-RR
	0.75	1	4.5	284A-FHB4P5Z-10-RR	284A-FHB4P5D-10-RR	284A-FHB4P5B-10-RR
	1.5	2	7.6	284A-FHB7P6Z-25-RR	284A-FHB7P6D-25-RR	284A-FHB7P6B-25-RR
380…480V, 50/60 Hz 3-Phase	0.4	0.5	1.4	284A-FHD1P4Z-10-RR	284A-FHD1P4D-10-RR	284A-FHD1P4B-10-RR
	0.75	1	2.3	284A-FHD2P3Z-10-RR	284A-FHD2P3D-10-RR	284A-FHD2P3B-10-RR
	1.5	2	4	284A-FHD4P0Z-10-RR	284A-FHD4P0D-10-RR	284A-FHD4P0B-10-RR
	2.2	3	6	284A-FHD6P0Z-25-RR	284A-FHD6P0D-25-RR	284A-FHD6P0B-25-RR
	3	5	7.6	284A-FHD7P6Z-25-RR	284A-FHD7P6D-25-RR	284A-FHD7P6B-25-RR

Sensorless Vector Control (SVC), typical of Powerflex 40 Class Drive

Examples given in this section are for reference purposes. This basic explanation should not be used for product selection; not all combinations will produce a valid catalog number.

284	D	–	F	V	D2P3	D	–	10	–	CR	–	Option 1	–	Option 2	–	Option 3
a	*b*		*c*	*d*	*e*	*f*		*g*		*h*		*i*		*j*		*k*

a

Bulletin Number	
Code	Description
284	VFD Starter

b

Communications	
Code	Description
E	EtherNet/IP
D	DeviceNet
A	ArmorPoint

c

Enclosure Type	
Code	Description
F	Type 4 (IP67)
S❄	Type 4X

d

Torque Performance Mode	
Code	Description
V	Sensorless Vector Control and Volts per Hertz

e

Output Current					
200…240V❄		380…480V		500…600V❄	
Code	Description	Code	Description	Code	Description
B2P3	2.3 A, 0.4 kW, 0.5 Hp	D1P4	1.4 A, 0.4 kW, 0.5 Hp	E1P7	1.7 A, 0.75 kW, 1.0 Hp
B5P0	5.0 A, 0.75 kW, 1.0 Hp	D2P3	2.3 A, 0.75 kW, 1.0 Hp	E3P0	3.0 A, 1.5 kW, 2.0 Hp
B7P6	7.6 A, 1.5 kW, 2.0 Hp	D4P0	4.0 A, 1.5 kW, 2.0 Hp	E4P2	4.2 A, 2.2 kW, 3.0 Hp
—	—	D6P0	6.0 A, 2.2 kW, 3.0 Hp	E6P6	6.6 A, 4.0 kW, 5.0 Hp
—	—	D7P6	7.6 A, 3.3 kW, 5.0 Hp	—	—

f

Control Voltage	
Code	Description
Z	24V DC
D❄	120V AC
B❄	240V AC

g

Short Circuit Protection (Motor Circuit Protector)	
Code	Description
10	10 A Rated Device
25	25 A Rated Device

h

Control and 3-Phase Power Connections / Motor Cable Connection (CR: Conduit/Round Media) or (RR: Round/Round Media)				
Code		Description		
		Control Power	3-Phase Power	Motor Cable
CR	blank	Conduit Entrance	Conduit Entrance	3 m, unshielded cordset male 90°
CR	N	Conduit Entrance	Conduit Entrance	3 m, shielded cordset male 90°
CR	W ✶	Conduit Entrance	Conduit Entrance	No cable
RR	blank	Round Media (Male Receptacle)	Round Media (Male Receptacle)	3 m, unshielded cordset male 90°
RR	N	Round Media (Male Receptacle)	Round Media (Male Receptacle)	3 m, shielded cordset male 90°
RR	W ✶	Round Media (Male Receptacle)	Round Media (Male Receptacle)	No cable

i

Option 1	
Code	Description
3	Hand/Off/Auto Selector Keypad with Jog Function

j

Option 2		
Code		Description
CB❄	blank	Control Brake Contactor
CB❄	W ✶	No cable
DB	blank	DB Brake Connector
DB1	blank	Connectivity to IP67 DB Resistor
SB	blank	Source Brake Contactor
SB	W ✶	No cable

k

Option 3	
Code	Description
A10❄	0…10V Analog Input
EMI	EMI Filter
OC	Output Contactor
SM❄‡§	Safety Monitor

✶ See Accessories on page 4-82 for extended motor and brake cable lengths.
❄ Not available with EtherNet/IP.
‡ Not available with round media option (RR).
§ The output contactor is included with the Safety Monitor option.

EtherNet/IP Network Communication

IP67/NEMA Type 4 with conduit entrance, Sensorless Vector Control, and Volts per Hertz torque performance, Up to 480V AC

Input Voltage	3-Phase kW Rating	3-Phase Hp Rating	Output Current [A]	24V DC Control Voltage
				Cat. No.
380...480V, 50/60 Hz 3-Phase	0.4	0.5	1.4	284E-FVD1P4Z-10-CR
	0.75	1	2.3	284E-FVD2P3Z-10-CR
	1.5	2	4	284E-FVD4P0Z-10-CR
	2.2	3	6	284E-FVD6P0Z-25-CR
	3	5	7.6	284E-FVD7P6Z-25-CR

IP67/NEMA Type 4 with quick disconnects for ArmorConnect power media, Sensorless Vector Control, and Volts per Hertz torque performance, Up to 480V AC

Input Voltage	3-Phase kW Rating	3-Phase Hp Rating	Output Current [A]	24V DC Control Voltage
				Cat. No.
380…480V, 50/60 Hz 3-Phase	0.4	0.5	1.4	284E-FVD1P4Z-10-RR
	0.75	1	2.3	284E-FVD2P3Z-10-RR
	1.5	2	4	284E-FVD4P0Z-10-RR
	2.2	3	6	284E-FVD6P0Z-25-RR
	3	5	7.6	284E-FVD7P6Z-25-RR

DeviceNet Network Communication

IP67/NEMA Type 4 with conduit entrance, Sensorless Vector Control, and Volts per Hertz torque performance, Up to 575V AC

Input Voltage	3-Phase kW Rating	3-Phase Hp Rating	Output Current [A]	24V DC Control Voltage	120V AC Control Voltage	240V AC Control Voltage
				Cat. No.	Cat. No.	Cat. No.
200...240V, 50/60 Hz 3-Phase	0.4	0.5	2.3	284D-FVB2P3Z-10-CR	284D-FVB2P3D-10-CR	284D-FVB2P3B-10-CR
	0.75	1	5	284D-FVB5P0Z-10-CR	284D-FVB5P0D-10-CR	284D-FVB5P0B-10-CR
	1.5	2	7.6	284D-FVB7P6Z-25-CR	284D-FVB7P6D-25-CR	284D-FVB7P6B-25-CR
380...480V, 50/60 Hz 3-Phase	0.4	0.5	1.4	284D-FVD1P4Z-10-CR	284D-FVD1P4D-10-CR	284D-FVD1P4B-10-CR
	0.75	1	2.3	284D-FVD2P3Z-10-CR	284D-FVD2P3D-10-CR	284D-FVD2P3B-10-CR
	1.5	2	4	284D-FVD4P0Z-10-CR	284D-FVD4P0D-10-CR	284D-FVD4P0B-10-CR
	2.2	3	6	284D-FVD6P0Z-25-CR	284D-FVD6P0D-25-CR	284D-FVD6P0B-25-CR
	3	5	7.6	284D-FVD7P6Z-25-CR	284D-FVD7P6D-25-CR	284D-FVD7P6B-25-CR
460…600V, 50/60 Hz 3-Phase	0.75	1	1.7	284D-FVE1P7Z-10-CR	284D-FVE1P7D-10-CR	284D-FVE1P7B-10-CR
	1.5	2	3	284D-FVE3P0Z-10-CR	284D-FVE3P0D-10-CR	284D-FVE3P0B-10-CR
	2.2	3	4.2	284D-FVE4P2Z-10-CR	284D-FVE4P2D-10-CR	284D-FVE4P2B-10-CR
	4	5	6.1	284D-FVE6P6Z-25-CR	284D-FVE6P6D-25-CR	284D-FVE6P6B-25-CR

IP67/NEMA Type 4 with quick disconnects for ArmorConnect power media, Sensorless Vector Control, and Volts per Hertz torque performance, Up to 575V AC

Input Voltage	3-Phase kW Rating	3-Phase Hp Rating	Output Current [A]	24V DC Control Voltage	120V AC Control Voltage	240V AC Control Voltage
				Cat. No.	Cat. No.	Cat. No.
200…240V, 50/60 Hz 3-Phase	0.4	0.5	2.3	284D-FVB2P3Z-10-RR	284D-FVB2P3D-10-RR	284D-FVB2P3B-10-RR
	0.75	1	5	284D-FVB5P0Z-10-RR	284D-FVB5P0D-10-RR	284D-FVB5P0B-10-RR
	1.5	2	7.6	284D-FVB7P6Z-25-RR	284D-FVB7P6D-25-RR	284D-FVB7P6B-25-RR
380…480V, 50/60 Hz 3-Phase	0.4	0.5	1.4	284D-FVD1P4Z-10-RR	284D-FVD1P4D-10-RR	284D-FVD1P4B-10-RR
	0.75	1	2.3	284D-FVD2P3Z-10-RR	284D-FVD2P3D-10-RR	284D-FVD2P3B-10-RR
	1.5	2	4	284D-FVD4P0Z-10-RR	284D-FVD4P0D-10-RR	284D-FVD4P0B-10-RR
	2.2	3	6	284D-FVD6P0Z-25-RR	284D-FVD6P0D-25-RR	284D-FVD6P0B-25-RR
	3	5	7.6	284D-FVD7P6Z-25-RR	284D-FVD7P6D-25-RR	284D-FVD7P6B-25-RR
460…600V, 50/60 Hz 3-Phase	0.75	1	1.7	284D-FVE1P7Z-10-RR	284D-FVE1P7D-10-RR	284D-FVE1P7B-10-RR
	1.5	2	3	284D-FVE3P0Z-10-RR	284D-FVE3P0D-10-RR	284D-FVE3P0B-10-RR
	2.2	3	4.2	284D-FVE4P2Z-10-RR	284D-FVE4P2D-10-RR	284D-FVE4P2B-10-RR
	4	5	6.1	284D-FVE6P6Z-25-RR	284D-FVE6P6D-25-RR	284D-FVE6P6B-25-RR

DeviceNet Network Communication, Continued

NEMA Type 4X with conduit entrance, Sensorless Vector Control, and Volts per Hertz torque performance, Up to 575V AC

Input Voltage	3-Phase kW Rating	3-Phase Hp Rating	Output Current [A]	24V DC Control Voltage Cat. No.	120V AC Control Voltage Cat. No.	240V AC Control Voltage Cat. No.
200…240V, 50/60 Hz 3-Phase	0.4	0.5	2.3	284D-SVB2P3Z-10-CR	284D-SVB2P3D-10-CR	284D-SVB2P3B-10-CR
	0.75	1	5	284D-SVB5P0Z-10-CR	284D-SVB5P0D-10-CR	284D-SVB5P0B-10-CR
	1.5	2	7.6	284D-SVB7P6Z-25-CR	284D-SVB7P6D-25-CR	284D-SVB7P6B-25-CR
380…480V, 50/60 Hz 3-Phase	0.4	0.5	1.4	284D-SVD1P4Z-10-CR	284D-SVD1P4D-10-CR	284D-SVD1P4B-10-CR
	0.75	1	2.3	284D-SVD2P3Z-10-CR	284D-SVD2P3D-10-CR	284D-SVD2P3B-10-CR
	1.5	2	4	284D-SVD4P0Z-10-CR	284D-SVD4P0D-10-CR	284D-SVD4P0B-10-CR
	2.2	3	6	284D-SVD6P0Z-25-CR	284D-SVD6P0D-25-CR	284D-SVD6P0B-25-CR
	3	5	7.6	284D-SVD7P6Z-25-CR	284D-SVD7P6D-25-CR	284D-SVD7P6B-25-CR
460…600V, 50/60 Hz 3-Phase	0.75	1	1.7	284D-SVE1P7Z-10-CR	284D-SVE1P7D-10-CR	284D-SVE1P7B-10-CR
	1.5	2	3	284D-SVE3P0Z-10-CR	284D-SVE3P0D-10-CR	284D-SVE3P0B-10-CR
	2.2	3	4.2	284D-SVE4P2Z-10-CR	284D-SVE4P2D-10-CR	284D-SVE4P2B-10-CR
	4	5	6.1	284D-SVE6P6Z-25-CR	284D-SVE6P6D-25-CR	284D-SVE6P6B-25-CR

NEMA Type 4X with quick disconnects for ArmorConnect power media, Sensorless Vector Control, and Volts per Hertz torque performance, Up to 575V AC

Input Voltage	3-Phase kW Rating	3-Phase Hp Rating	Output Current [A]	24V DC Control Voltage Cat. No.	120V AC Control Voltage Cat. No.	240V AC Control Voltage Cat. No.
200…240V, 50/60 Hz 3-Phase	0.4	0.5	2.3	284D-SVB2P3Z-10-RR	284D-SVB2P3D-10-RR	284D-SVB2P3B-10-RR
	0.75	1	5	284D-SVB5P0Z-10-RR	284D-SVB5P0D-10-RR	284D-SVB5P0B-10-RR
	1.5	2	7.6	284D-SVB7P6Z-25-RR	284D-SVB7P6D-25-RR	284D-SVB7P6B-25-RR
380…480V, 50/60 Hz 3-Phase	0.4	0.5	1.4	284D-SVD1P4Z-10-RR	284D-SVD1P4D-10-RR	284D-SVD1P4B-10-RR
	0.75	1	2.3	284D-SVD2P3Z-10-RR	284D-SVD2P3D-10-RR	284D-SVD2P3B-10-RR
	1.5	2	4	284D-SVD4P0Z-10-RR	284D-SVD4P0D-10-RR	284D-SVD4P0B-10-RR
	2.2	3	6	284D-SVD6P0Z-25-RR	284D-SVD6P0D-25-RR	284D-SVD6P0B-25-RR
	3	5	7.6	284D-SVD7P6Z-25-RR	284D-SVD7P6D-25-RR	284D-SVD7P6B-25-RR
460…600V, 50/60 Hz 3-Phase	0.75	1	1.7	284D-SVE1P7Z-10-RR	284D-SVE1P7D-10-RR	284D-SVE1P7B-10-RR
	1.5	2	3	284D-SVE3P0Z-10-RR	284D-SVE3P0D-10-RR	284D-SVE3P0B-10-RR
	2.2	3	4.2	284D-SVE4P2Z-10-RR	284D-SVE4P2D-10-RR	284D-SVE4P2B-10-RR
	4	5	6.1	284D-SVE6P6Z-25-RR	284D-SVE6P6D-25-RR	284D-SVE6P6B-25-RR

ArmorPoint Bus Network Communication

IP67/NEMA Type 4 with conduit entrance, Sensorless Vector Control, and Volts per Hertz torque performance, Up to 575V AC

Input Voltage	3-Phase kW Rating	3-Phase Hp Rating	Output Current [A]	24V DC Control Voltage Cat. No.	120V AC Control Voltage Cat. No.	240V AC Control Voltage Cat. No.
200…240V, 50/60 Hz 3-Phase	0.4	0.5	2.3	284A-FVB2P3Z-10-CR	284A-FVB2P3D-10-CR	284A-FVB2P3B-10-CR
	0.75	1	5	284A-FVB5P0Z-10-CR	284A-FVB5P0D-10-CR	284A-FVB5P0B-10-CR
	1.5	2	7.6	284A-FVB7P6Z-25-CR	284A-FVB7P6D-25-CR	284A-FVB7P6B-25-CR
380…480V, 50/60 Hz 3-Phase	0.4	0.5	1.4	284A-FVD1P4Z-10-CR	284A-FVD1P4D-10-CR	284A-FVD1P4B-10-CR
	0.75	1	2.3	284A-FVD2P3Z-10-CR	284A-FVD2P3D-10-CR	284A-FVD2P3B-10-CR
	1.5	2	4	284A-FVD4P0Z-10-CR	284A-FVD4P0D-10-CR	284A-FVD4P0B-10-CR
	2.2	3	6	284A-FVD6P0Z-25-CR	284A-FVD6P0D-25-CR	284A-FVD6P0B-25-CR
	3	5	7.6	284A-FVD7P6Z-25-CR	284A-FVD7P6D-25-CR	284A-FVD7P6B-25-CR
460…600V, 50/60 Hz 3-Phase	0.75	1	1.7	284A-FVE1P7Z-10-CR	284A-FVE1P7D-10-CR	284A-FVE1P7B-10-CR
	1.5	2	3	284A-FVE3P0Z-10-CR	284A-FVE3P0D-10-CR	284A-FVE3P0B-10-CR
	2.2	3	4.2	284A-FVE4P2Z-10-CR	284A-FVE4P2D-10-CR	284A-FVE4P2B-10-CR
	4	5	6.1	284A-FVE6P6Z-25-CR	284A-FVE6P6D-25-CR	284A-FVE6P6B-25-CR

4

IP67/NEMA Type 4 with quick disconnects for ArmorConnect power media, Sensorless Vector Control, and Volts per Hertz torque performance, Up to 575V AC

Input Voltage	3-Phase kW Rating	3-Phase Hp Rating	Output Current [A]	24V DC Control Voltage Cat. No.	120V AC Control Voltage Cat. No.	240V AC Control Voltage Cat. No.
200…240V, 50/60 Hz 3-Phase	0.4	0.5	2.3	284A-FVB2P3Z-10-RR	284A-FVB2P3D-10-RR	284A-FVB2P3B-10-RR
	0.75	1	5	284A-FVB5P0Z-10-RR	284A-FVB5P0D-10-RR	284A-FVB5P0B-10-RR
	1.5	2	7.6	284A-FVB7P6Z-25-RR	284A-FVB7P6D-25-RR	284A-FVB7P6B-25-RR
380…480V, 50/60 Hz 3-Phase	0.4	0.5	1.4	284A-FVD1P4Z-10-RR	284A-FVD1P4D-10-RR	284A-FVD1P4B-10-RR
	0.75	1	2.3	284A-FVD2P3Z-10-RR	284A-FVD2P3D-10-RR	284A-FVD2P3B-10-RR
	1.5	2	4	284A-FVD4P0Z-10-RR	284A-FVD4P0D-10-RR	284A-FVD4P0B-10-RR
	2.2	3	6	284A-FVD6P0Z-25-RR	284A-FVD6P0D-25-RR	284A-FVD6P0B-25-RR
	3	5	7.6	284A-FVD7P6Z-25-RR	284A-FVD7P6D-25-RR	284A-FVD7P6B-25-RR
460…600V, 50/60 Hz 3-Phase	0.75	1	1.7	284A-FVE1P7Z-10-RR	284A-FVE1P7D-10-RR	284A-FVE1P7B-10-RR
	1.5	2	3	284A-FVE3P0Z-10-RR	284A-FVE3P0D-10-RR	284A-FVE3P0B-10-RR
	2.2	3	4.2	284A-FVE4P2Z-10-RR	284A-FVE4P2D-10-RR	284A-FVE4P2B-10-RR
	4	5	6.1	284A-FVE6P6Z-25-RR	284A-FVE6P6D-25-RR	284A-FVE6P6B-25-RR

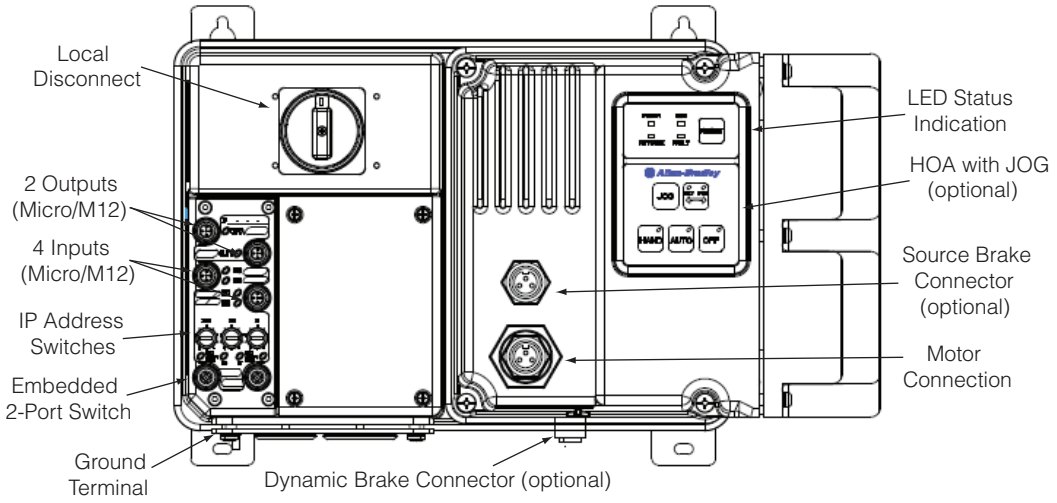
Options — Factory Installed

Description		Cat. No. Modification
	Hand/Off/Auto Selector and Jog Keypad	-3
	Safety Monitor (includes output contactor)❄‡	-SM
	EMI Filter	-EMI
	Output Contactor	-OC
	Shielded motor cable	-CRN
	Supplied without motor cable	-CRW
	Control Brake supplied with cable❄	-CB
	Control Brake supplied without cable❄	-CBW
	Source brake supplied with cable	-SB
	Source brake supplied without cable	-SBW
	0…10 Analog Input❄	-A10
	Dynamic Brake Connector (IP20 brake)	-DB
	Dynamic Brake Connector (IP67 brake)	-DB1
	ArmorConnect Power Media Connectivity, ArmorStart supplied with shielded motor cable	-RRN
	ArmorConnect Power Media Connectivity, ArmorStart supplied without motor cable	-RRW

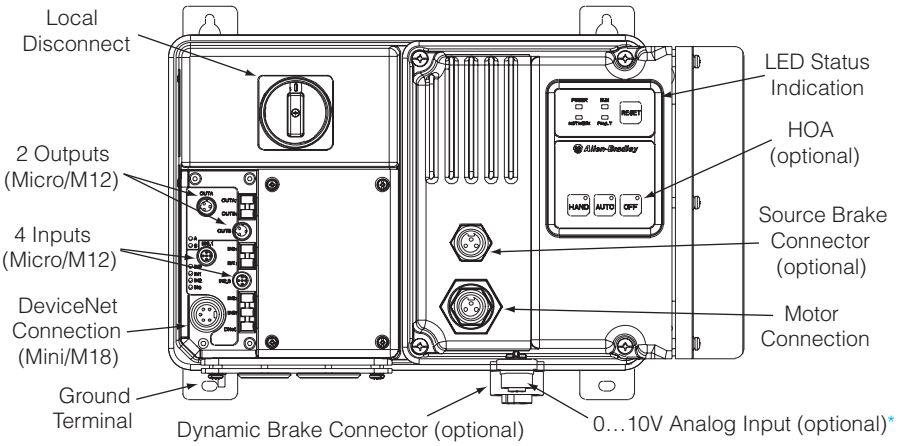
❄ Not available with EtherNet/IP communications.
‡ Not available with round media option (RR).

Connections

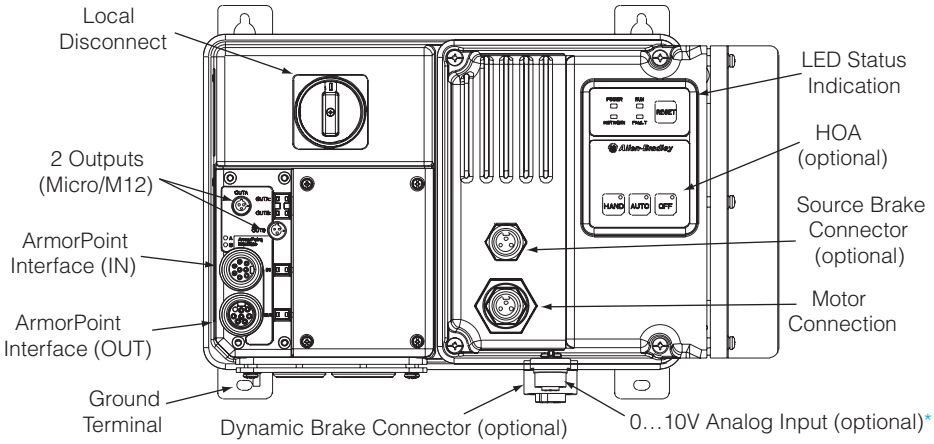
Bulletin 284E ArmorStart with EtherNet/IP Communications



Bulletin 284D ArmorStart with DeviceNet Communications



Bulletin 284A ArmorStart for the ArmorPoint Backplane



* Only available with SVC.

ArmorStart Receptacle Pin Outs

Receptacle Connections for 0…10V Analog Input (M22)

Pin 1: 10V DC
Pin 2: 0…10V input
Pin 3: Analog common
Pin 4: Analog output
Pin 5: NC (no connection)

Receptacle Connections for ArmorPoint Interface (OUT)

Pin 1: CAN high
Pin 2: Common
Pin 3: +5V
Pin 4: CAN low
Pin 5: Enable out
Pin 7: Common
Pin 8: NC (no connection)

Receptacle Connections for ArmorPoint Interface (IN)

Pin 1: CAN high
Pin 2: Common
Pin 3: +5V
Pin 4: CAN low
Pin 5: Enable out
Pin 7: Common
Pin 8: PE

Receptacle Connections for DeviceNet Connector

Pin 1: Drain (no connection)
Pin 2: +VDNET
Pin 3: -VDNET
Pin 4: CAN_H
Pin 5: CAN_L

Receptacle Connections for EtherNet/IP (M12)

Pin 1: Tx+
Pin 2: Rx+
Pin 3: Tx-
Pin 4: Rx-

Receptacle Connections for Input (M12)

Pin 1: +24V (A3 or DNET)
Pin 2: Input 0
Pin 3: Common
Pin 4: Input 1
Pin 5: NC (no connection)

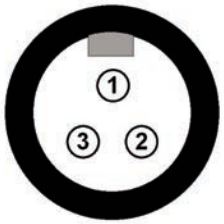
Receptacle Connections for Output, EtherNet/IP Version (M12)

Pin 1: NC (no connection)
Pin 2: NC (no connection)
Pin 3: Common
Pin 4: Output +24V DC (A1)
Pin 5: NC (no connection)

Receptacle Connections for Output, DeviceNet or ArmorPoint Version (M12)

Pin 1: PE
Pin 2: Return
Pin 3: Relay out

Receptacle Connections for Dynamic Brake (M22)



Pin 1: GND (green/yellow)
Pin 2: BR+ (black)
Pin 3: BR- (white)

Receptacle Connections for Incoming Control Power (M22)

Pin 1: Unswitched (A3)(red)
Pin 2: Common (A2)(black)
Pin 3: PE (green)
Pin 4: Not used (blank)
Pin 5: Switched (A1)(blue)
Pin 6: Not used (white)

ArmorStart Receptacle Pin Outs, Continued

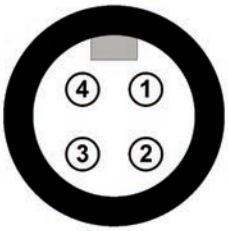
Receptacle Connections for Source or Control Brake (M25)

Pin 1: L1 (black)
Pin 2: GND (green/yellow)
Pin 3: L2 (white)

Receptacle Connections for Incoming 3-phase Power - 10 A Short Circuit Protection (M22)

Pin 1: L1 (black)
Pin 2: L2 (white)
Pin 3: L3 (red)
Pin 4: Ground (green/yellow)

Receptacle Connections for Motor Connector (M22)



Pin 1: T1 (black)
Pin 2: T2 (white)
Pin 3: T3 (red)
Pin 4: Ground (green/yellow)

Receptacle Connections for Incoming 3-phase Power - 25 A Short Circuit Protection (M35)

Pin 1: L1 (black)
Pin 2: Ground (green/yellow)
Pin 3: L3 (red)
Pin 4: L2 (white)

Electrical Ratings		UL/NEMA	IEC
Power Circuit	Rated Operation Voltage	200…575V	200…500V
	Rate Insulation Voltage	600V	600V
	Rated Impulsed Voltage	6 kV	6 kV
	Dielectric Withstand	2200V AC	2500V AC
	Operating Frequency	50/60 Hz	50/60 Hz
	Utilization Category	N/A	AC-3
	Protection Against Shock	N/A	IP2X
	Rated Maximum Operating Current	2.5 A	
		5.5 A	
		16 A	
Control Circuit	Rated Operation Voltage	24V DC (+10%, -15%) A2 (should be grounded at voltage source)	
		120V AC (+10%, -15%) A2 (should be grounded at voltage source)	
		240V AC (+10%, -15%) A2 (should be grounded at voltage source)	
	Rate Insulation Voltage	250V	250V
	Rated Impulsed Voltage	—	4 kV
	Dielectric Withstand	1500V AC	2000V AC
	Overvoltage Category	—	III
	Operating Frequency	50/60 Hz	50/60 Hz

Short Circuit Protection	SCPD Performance Type 1	Current Rating	Voltage	480Y/277V	480Y/480V	600Y/347V	600V
		10 A	Sym. Amps RMS	65 kA	65 kA	30 kA	30 kA
		25 A		30 kA	30 kA	30 kA	30 kA
	SCPD List	Size per NFPA 70 (NEC) or NFPA 79 for Group Motor Applications					

		UL/NEMA	IEC
Environmental	Operating Temperature Range	-20…+40 °C (-4…+104 °F)	
	Storage and Transportation Temperature Range	–25….+85 °C (–13…+185 °F)	
	Altitude	1000 m	
	Humidity	5…95% (non-condensing)	
	Pollution Degree	3	
	Enclosure Ratings	NEMA 4/12/13	IP67
		NEMA 4X	IP69K
	Approximate Shipping Weight	13.6 kg (30 lb)	
Mechanical	**Resistance to Shock**		
	Operational	15 G	
	Non-Operational	30 G	
	Resistance to Vibration		
	Operational	1 G, 0.15 mm (0.006 in.) displacement	
	Non-Operational	2.5 G, 0.38 mm (0.015 in.) displacement	
	Wire Size	Primary/Secondary terminal: (16 …10 AWG)	Primary/Secondary terminal: 1.5…4.0 mm²
	Tightening Torque	Primary terminal: 10.8 lb•in Secondary terminal: 4.5 lb•in	Primary terminal: (1.2 N•m) Secondary terminal: (0.5 N•m)
	Wire Strip Length	0.35 in. (9 mm)	
	Control and Safety Monitor Inputs		
	Wire Size	(18…10 AWG)	1.0…4.0 mm²
	Tightening Torque	6.2 lb•in	0.7 N•m
	Wire Strip Length	0.35 in. (9 mm)	
	Disconnect Lock Out	Maximum of 5/16 in. (8 mm) lock shackle or hasp. The hasp should not exceed 5/16 in. (8 mm) when closed, or damage will occur to disconnect guard.	
EMC Emission Levels	Conducted Radio Frequency Emissions	10V rms Communication cables 10V rms (PE) 150 kHz…80 MHz	
	Radiated Emissions	Class A	
EMC Immunity Levels	Electrostatic Discharge	4 kV contact and 8 kV Air	
	Radio Frequency Electromagnetic Field	10V/m, 80 KHz…1 GHz 3V/m, 1.4 GHz…2.0 GHz 1V/m, 2.0 GHz…2.7 GHz	
	Fast Transient	2 kV (Power) 2 kV (PE) 1 kV (Communications and control)	
	Surge Transient	1 kV (12) $_{L-L}$, 2 kV (2) $_{L-N}$ (earth)	
Standards Compliance		UL 508C; CSA C22.2, No. 14; EN50178; EN61800-3; EN/IEC 60947-4-2; CE Marked per Low Voltage 2006/95/EC; EMC Directive 2004/108/EC; CCC; ODVA for EtherNet/IP; ODVA for DeviceNet	
Certifications		cULus (File No. E207834, Guide NMMS, NMMS7)	

ArmorPoint and DeviceNet Versions — Control and I/O Power Requirements										
	Units	No Options			Brake or Output Contactor			With Brake and Output Contactor		
Control Voltage	Volts	24V DC	120V AC	240V AC	24V DC	120V AC	240V AC	24V DC	120V AC	240V AC
Total Control VA (Pick Up)	VA (W)	(11 W)	16	24	(13 W)	38	46	(16 W)	60	68
Total Control VA (Hold In)	VA (W)	(11 W)	16	24	(13 W)	20	28	(16 W)	24	32
External Devices powered by Control Voltage										
Outputs (2) (1 A max. each)	Amps	2	2	2	2	2	2	2	2	2
Total Control VA (Pick Up) with max. outputs	VA (W)	(59 W)	256	504	(61 W)	278	548	(64 W)	300	548
Total Control VA (Hold In) with max. outputs	VA (W)	(59 W)	256	504	(61 W)	261	512	(64 W)	264	512

		UL/NEMA	IEC
Input Ratings	Rated Operation Voltage	24V DC	
	Input On-State Voltage Range	10…26V DC	
	Input On-State Current	3.0 mA @ 10V DC	
		7.2 mA @ 24V DC	
	Input Off-State Voltage Range	0…5V DC	
	Input Off-State Current	<1.5 mA	
	Input Filter — Software Selectable		
	Off to On	Settable from 0…64 ms in 1 ms increments	
	On to Off	Settable from 0…64 ms in 1 ms increments	
	Input Compatibility	N/A	IEC 1+
	Number of Inputs	4	
	Sensor Source		
	Voltage Status Only	11…25V DC from DeviceNet	
	Current Available	50 mA max. per input, 200 mA total	
Output Ratings Sourced from control circuit - A1/A2	Rated Operation Voltage	240V AC/30V DC	240V AC/30V DC
	Rate Insulation Voltage	250V	250V
	Dielectric Withstand	1500V AC	2000V AC
	Operating Frequency	50/60 Hz	
	Type of Control Circuit	Electromechanical relay	
	Type of Current	AC/DC	
	Conventional Thermal Current I_{th}	Total of both outputs ≤ 2 A	
	Type of Contacts	Normally open (N.O.)	
	Number of Contacts	2	
DeviceNet Specifications	DeviceNet Supply Voltage Rating	Range 11…25V DC, 24V DC nominal	
	DeviceNet Input Current	167 mA @ 24V DC - 4.0 W	
	DeviceNet Input Current	364 mA @ 11V DC - 4.0 W	
	External Devices powered by DeviceNet	Sensors inputs 4 x 50 mA - total 200 mA	
	Total w/max Sensor Inputs (4)	367 mA @ 24V DC - 8.8 W	
	DeviceNet Input Current Surge	15 A for 250 µs	
DeviceNet Communications	Baud Rates	125, 250, 500 kbps	
	Distance Maximum	500 m (1630 ft) @ 125 kbps	
	Distance Maximum	200 m (656 ft) @ 250 kbps	
	Distance Maximum	100 m (328 ft) @ 500 kbps	
ArmorPoint Ratings	Backplane Current Load	400 mA	

EtherNet/IP Version - Control and I/O Power Requirements				
	Units	A1/A2∗	A3/A2❄	A3/A2‡
Control Voltage	Volts	24V DC		
Current	Amps	0.375	0.125	0.35
Total Control Power (no options)	Watts	9	3	8.4
Total Control Power (with Dynamic Brake **or** Output Contactor option)	Watts	12	3	8.4
Total Control Power (with Dynamic Brake **and** Output Contactor option)	Watts	15	3	8.4

∗ Add power requirements for outputs (1 A max.) to A1/A2.
❄ Add power requirements for intputs (200 mA max.) to A3/A2.
‡ If A1 power is disconnected.

		UL/NEMA	IEC
Input Ratings Sourced from control circuit - A3/A2	Rated Operation Voltage	24V DC	
	Input On-State Voltage Range	10…26V DC	
	Input On-State Current	3.0 mA @ 10V DC	
		7.2 mA @ 24V DC	
	Input Off-State Voltage Range	0…5V DC	
	Input Off-State Current	<1.5 mA	
	Input Filter — Software Selectable		
	Off to On	Settable from 0…64 ms in 1 ms increments	
	On to Off	Settable from 0…64 ms in 1 ms increments	
	Input Compatibility	N/A	IEC 1+
	Number of Inputs	4	
	Sensor Source		
	Voltage Status Only	11…26.4V DC from DeviceNet	
	Current Available	50 mA max. per input, 200 mA total	
Output Ratings Sourced from control circuit - A1/A2	Rated Operation Voltage	26.4V DC	
	Rate Insulation Voltage	250V	
	Dielectric Withstand	1500V AC (UL)	2000V AC (IEC)
	Type of Control Circuit	Solid state sourcing output	
	Type of Current	24V DC	
	Conventional Thermal Current I_{th}	0.5 A each, 1 A max. combined	
	Type of Contacts	Normally open (N.O.)	
	Number of Contacts	2	
	Load Types	Resistive or light inductive	
	Surge Suppression	Integrated diode, clamps @ 35V DC	
	Thermo-Protection	Integrated short circuit and over current protection	
	Maximum Cycle Rate	30 operations/minute capacitive and inductive loads	
	Maximum Blocking Voltage	35V DC	
	Maximum On-State Voltage @ Maximum Output	1.5V DC	
	Maximum Off-State Leakage Current	10 µA	
Device Level Ring (DLR)		Beacon-based performance including IEEE 1588 end to end transparent clock	
	Maximum Nodes	50	
	Fault Recovery	Ring recovery time is less than 3 ms for a 50 node network	
EtherNet Port		2 D-coded, 4-pin female M12 connecters	
	Ports	Embedded switch with 2 ports	
	IP Address	DHCP enabled by default	
	DHCP Timeout	30 seconds	
	Communication Rate	10/100 Mbs with auto negotiate half duplex and full duplex	
	Data	• Transported over both TCP and UDP • Min. of 500 I/O packets/second (pps) • Supports up to 150 concurrent TCP sockets	
Web Server		Embedded web server	
	Security	Login and password configurable	
	E-mail	Support Simple Mail Transfer Protocol (SMTP)	
	Configuration	Status, diagnostics, and configuration tabs	
Device Connections		Supports scheduled (Class 1) and unscheduled (Class 3 & UCMM) connections	
		6 - Class 3 connections are supported simultaneously	
		Minimum of 1 - Class 1 or maximum of 2 - Class 1, CIP connections (1 exclusive owner, 1 input only and 1 listen only) are supported	
		Class 1 Connection API: 2…3200 ms Class 3 Connection API: 100…10 000 ms	
		20 ms Request Packet Interval (RPI) default	
		3 concurrent Encapsulation sessions	
		TCP port supports 5 concurrent incoming connections	

Drive Characteristics	Sensorless Vector Performance	Sensorless Vector Control
Maximum Hp (kW)/ Input Voltage	2 Hp (1.5 kW)/230V AC 5 Hp (3.3 kW)/480V AC	2 Hp (1.5 kW)/230V AC 5 Hp (3.3 kW)/480V AC, 5 Hp (4.0 kW)/600V AC
Overload Capacity	150% for 60 seconds, 200% for 3 seconds	150% for 60 seconds, 200% for 3 seconds
Output Frequency (programmable)	0…400 Hz	0…400 Hz
Efficiency (typical)	97.5%	97.5%
Preset Speeds	4	8
Carrier Frequency	2…16 kHz	2…16 kHz
Skip Frequency	—	✓
Process Control Loop	—	✓ (PID)
StepLogic Functionality	—	✓
Timer/Counter Functions	—	✓

Drive Ratings — VFD Output Current vs. Input Current							
				Output Current [A]		Input Current [A]	
Line Voltage	Frequency [Hz]	3-Phase kW Rating	3-Phase Hp Rating	Sensorless Vector Control	Sensorless Vector Performance	Sensorless Vector Control	Sensorless Vector Performance
200	50	0.4	—	2.3	—	3.65	—
		0.75	—	4.5	—	6.40	—
		1.5	—	7.6	—	10.65	—
230	60	—	0.5	2.3	2.3	3.10	2.5
		—	1	4.5	4.5	5.70	5.2
		—	2	7.6	7.6	9.45	9.5
380	50	0.4	—	1.4	—	2.15	—
		0.75	—	2.3	—	3.80	—
		1.5	—	4.0	—	6.40	—
		2.2	—	6.0	—	9.00	—
		3.0	—	7.6	—	12.40	—
460	60	—	0.5	1.4	1.4	1.85	1.8
		—	1	2.3	2.3	3.45	3.2
		—	2	4.0	4.0	5.57	5.7
		—	3	6.0	6.0	8.20	7.5
		—	5	7.6	7.6	12.5	8.6
575	60	—	1	1.7	—	2.78	—
		—	2	3.0	—	4.73	—
		—	3	4.2	—	6.64	—
		—	5	6.6	—	10.75	—

Protective Specifications — Sensorless Vector Performance	
Motor Protection	I^2t overload protection — 150% for 60 seconds, 200% for 3 seconds (provides Class 10 protection)
Overcurrent	200% hardware limit, 300% instantaneous fault
Over Voltage	200…240V AC Input — Trip occurs @ 405V DC bus voltage (equivalent to 290V AC incoming line) 380…460V AC Input — Trip occurs @ 810V DC bus voltage (equivalent to 575V AC incoming line)
Under Voltage	200…240V AC Input — Trip occurs @ 210V DC bus voltage (equivalent to 150V AC incoming line) 380…480V AC Input — Trip occurs @ 390V DC bus voltage (equivalent to 275V AC incoming line)
Faultless Power Ride Through	100 milliseconds

Control Specifications — Sensorless Vector Performance	
Carrier Frequency	2…16 kHz drive rating based on 4 kHz
Frequency Accuracy — Digital Input	within ±0.05% of set output frequency
Speed Regulation (open loop with slip compensation)	±2% of base speed across a 40:1 speed range
Stop Modes	Multiple programmable stop modes including: Ramp, Coast, DC-Brake, Ramp-to-Hold, and S Curve
Acceleration/Deceleration	Two independently programmable acceleration and deceleration times: each time may be programmed from 0…600 seconds in 0.1 second increments
Intermittent Overload	150% overload capability for up to 1 minute, 200% overload capability for up to 3 seconds
Electronic Motor Overload Protection	Class 10 protection with speed sensitive response and power-down overload retention function

Sensorless Vector Performance (SVP) Minimum DB Resistance			
Input Voltage	Drive Rating [kW]	Drive Rating [Hp]	Minimum DB Resistance [Ω]
200…240V, 50/60 Hz, Three-Phase	0.2	0.25	60
	0.4	0.5	60
	0.75	1	60
	1.5	2	60
480V, 50/60 Hz, Three-Phase	0.4	0.5	121
	0.75	1	121
	1.5	2	121
	2.2	3	97
	3.7	5	97

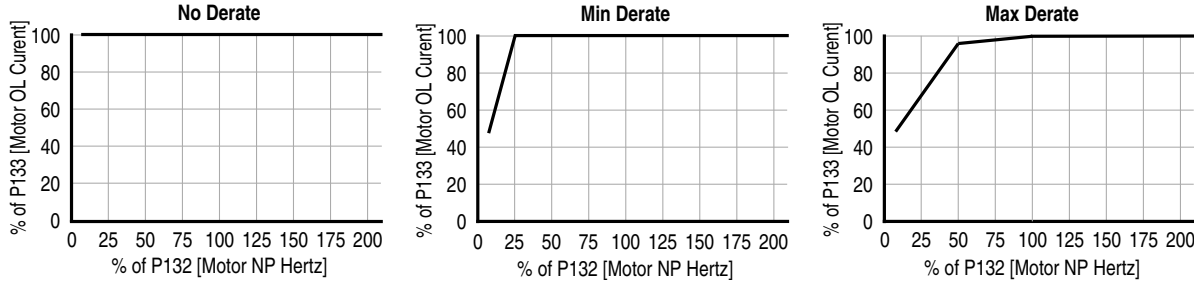
Protective Specifications — Sensorless Vector Control	
Motor Protection	I^2t overload protection — 150% for 60 seconds, 200% for 3 seconds (provides Class 10 protection)
Overcurrent	200% hardware limit, 300% instantaneous fault
Over Voltage	200…240V AC Input – Trip occurs @ 405V DC bus voltage (equivalent to 290V AC incoming line) 380…460V AC Input – Trip occurs @ 810V DC bus voltage (equivalent to 575V AC incoming line) 460…600V AC Input – Trip occurs @ 1005V DC bus voltage (equivalent to 711V AC incoming line)
Under Voltage	200…240V AC Input – Trip occurs @ 210V DC bus voltage (equivalent to 150V AC incoming line) 380…480V AC Input – Trip occurs @ 390V DC bus voltage (equivalent to 275V AC incoming line) 460…600V AC Input – If 600V rated trip occurs @ 487V DC bus voltage (344V AC incoming line); If 480V rated trip occurs @ 390V DC bus voltage (275V AC incoming line)
Faultless Power Ride Through	100 milliseconds

Control Specifications — Sensorless Vector Control	
Carrier Frequency	2…16 kHz drive rating based on 4 kHz
Frequency Accuracy — Digital Input	within ±0.05% of set output frequency
Speed Regulation (open loop with slip compensation)	±1% of base speed across a 60:1 speed range
Stop Modes	Multiple programmable stop modes including: Ramp, Coast, DC-Brake, Ramp-to-Hold, and S Curve
Acceleration/Deceleration	Two independently programmable acceleration and deceleration times: each time may be programmed from 0…600 seconds in 0.1 second increments
Intermittent Overload	150% overload capability for up to 1 minute, 200% overload capability for up to 3 seconds
Electronic Motor Overload Protection	Class 10 protection with speed sensitive response

Sensorless Vector Control (SVC) Minimum DB Resistance			
	Drive Rating		Minimum DB Resistance
Input Voltage	[kW]	[Hp]	[Ω]
240V, 50/60 Hz, Three-Phase	0.4	0.5	48
	0.75	1	48
	1.5	2	48
480V, 50/60 Hz, Three-Phase	0.4	0.5	97
	0.75	1	97
	1.5	2	97
	2.2	3	97
	4.0	5	77
600V, 50/60 Hz, Three-Phase	0.75	1	120
	1.5	2	120
	2.2	3	82
	4.0	5	82

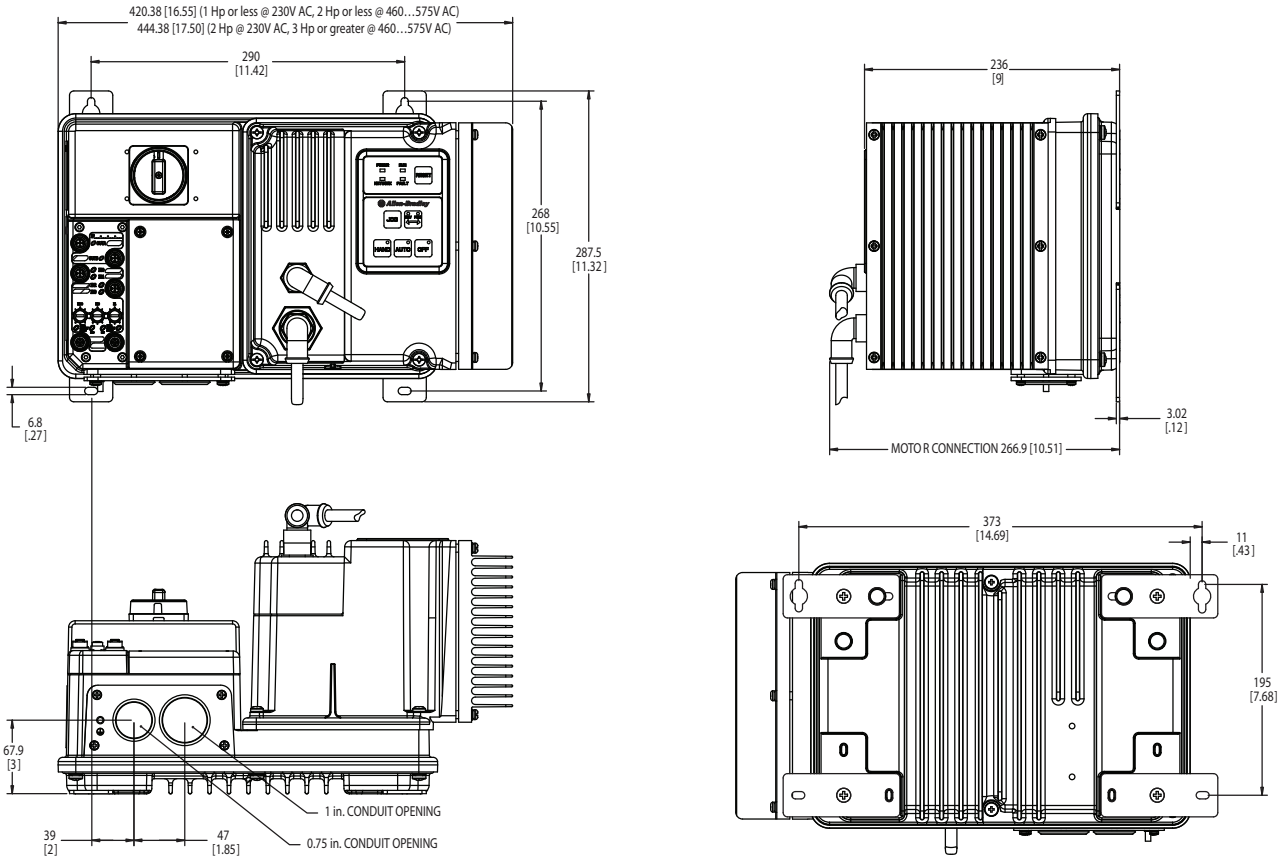
Motor Overload Trip Curves

Motor overload current parameter provides class 10 overload protection. Ambient insensitivity is inherent in the electronic design of the overload.



Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.

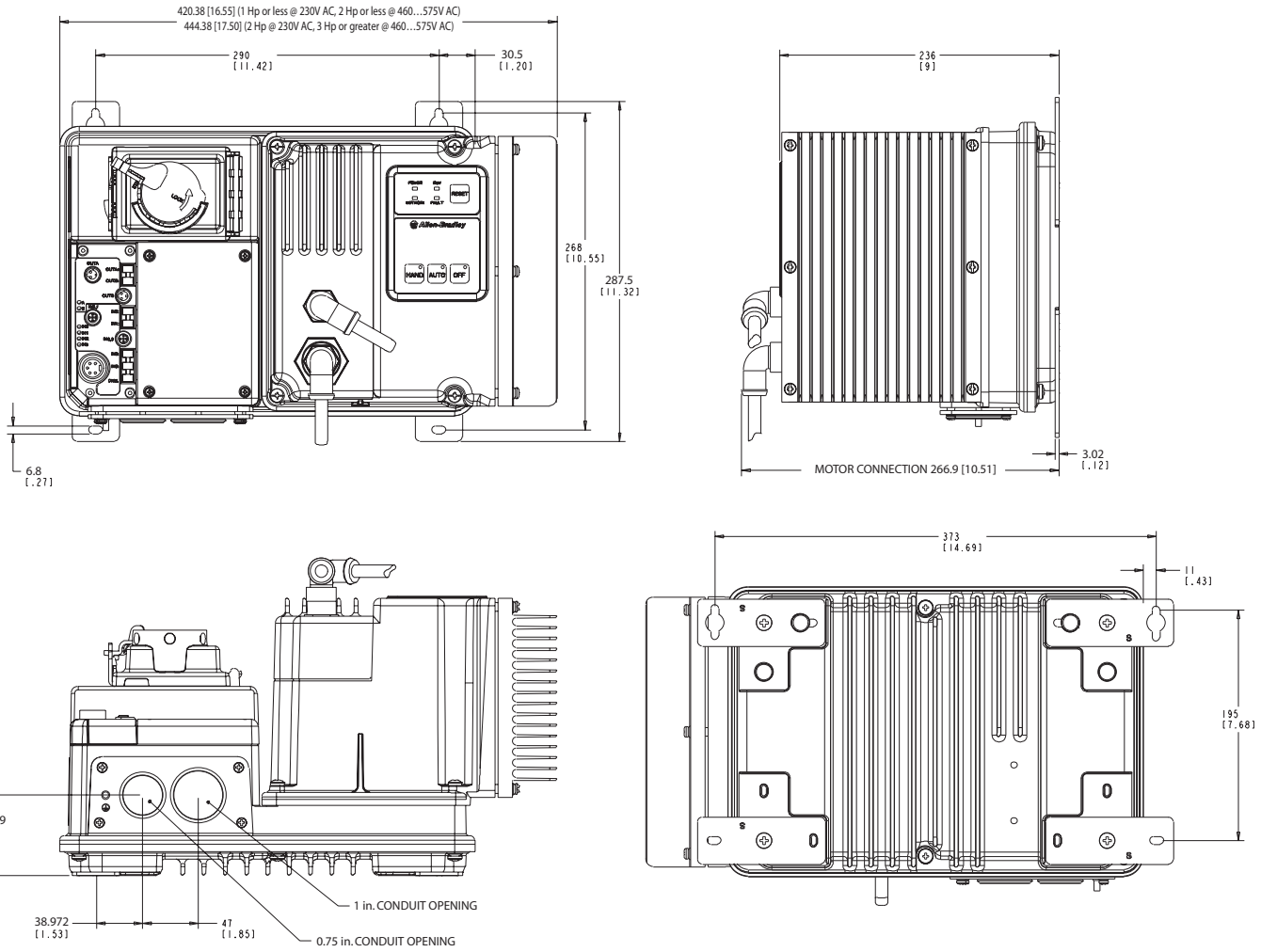
Dimensions for IP67/NEMA Type 4 with Conduit Entrance



4

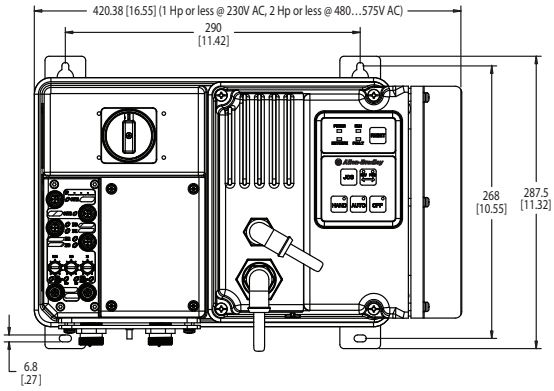
Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.

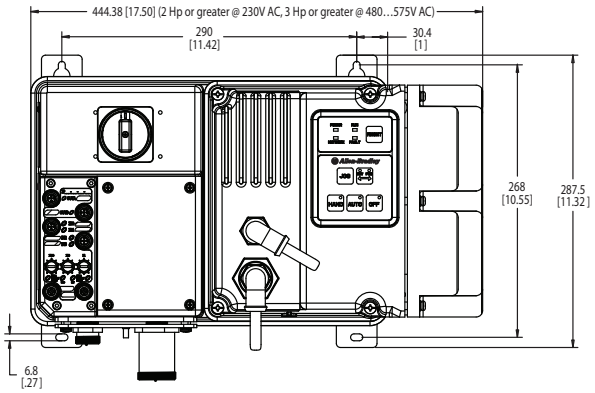
Dimensions for NEMA Type 4X with Conduit Entrance

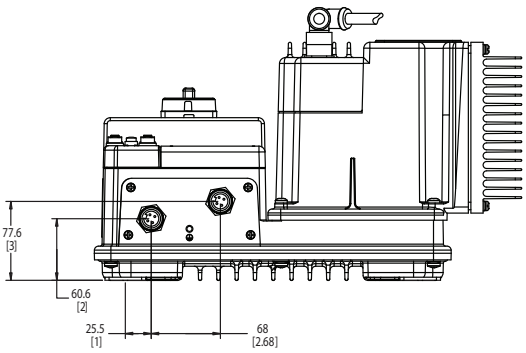


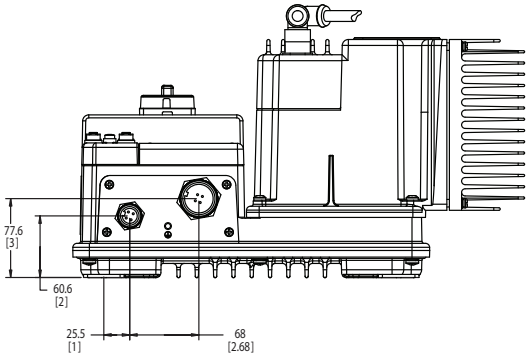
Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.

Dimensions for IP67/NEMA Type 4 with ArmorConnect Connectivity





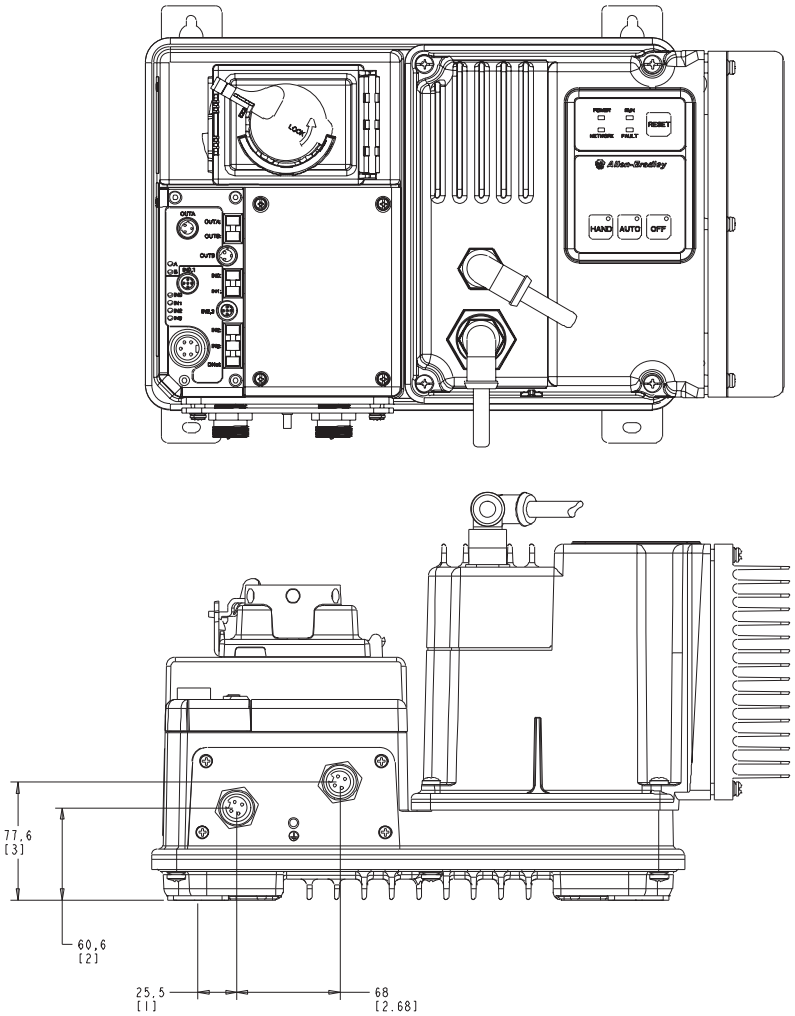




4

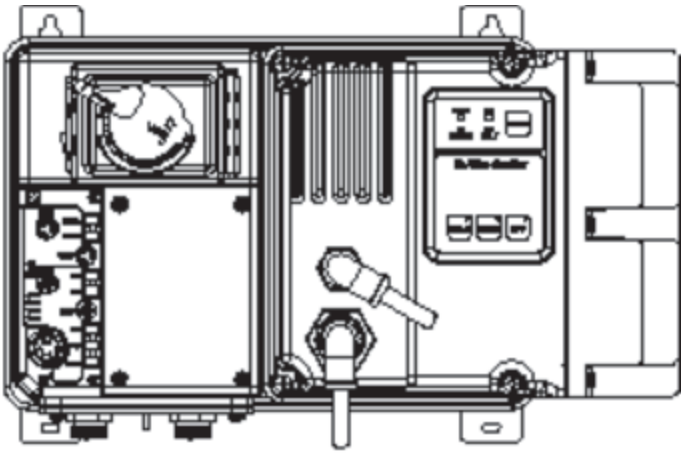
Dimensions for NEMA Type 4X with ArmorConnect Connectivity (1 Hp or less @ 230V AC and 2 Hp or less @ 480…575V AC)

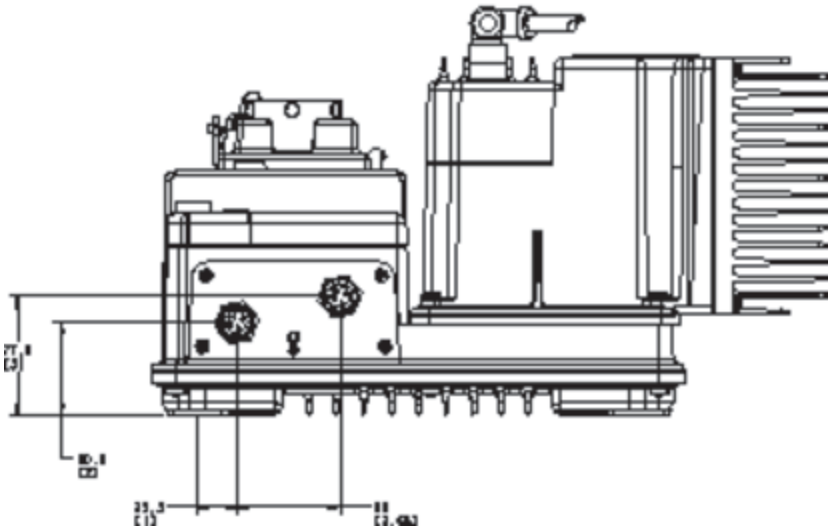
Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.



Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.

Dimensions for NEMA Type 4X with ArmorConnect Connectivity (2 Hp or greater @ 230V AC and 3 Hp or greater @ 480…575V AC)





Distributed Motor Controllers — Safety Version

Bulletin	280D	281D	284D
Horsepower Range:			
0.5…10 Hp (0.37…7.5 kW)	✓	✓	—
0.5…5 Hp (0.4…3.0 kW)	—	—	✓
Starting Method:			
Full-Voltage and Reversing	✓	✓	—
Sensorless Vector Control	—	—	✓
Environmental Rating:			
IP67/NEMA Type 4	✓	✓	✓
Control Voltage Rating: 24V DC	✓	✓	✓
Operational Voltage Ratings:			
200…480V AC	✓	✓	—
380…480V AC	—	—	✓
Rated for Group Motor Installations	✓	✓	✓
Network Communications with DeviceNet™ including DeviceLogix™	✓	✓	✓
I/O Capability:			
Four Inputs and Two Outputs	✓	✓	✓
LED Status Indication	✓	✓	✓
Gland Plate Entry:			
Conduit Entrance	✓	✓	✓
ArmorConnect Power Media	✓	✓	✓
Quick Disconnects (I/O, Communications, Motor Connection, Three-Phase and Control Power)	✓	✓	✓
Extended Length Motor and Brake Cables	✓	✓	✓
Factory Installed Options:			
HOA Keypad	✓	✓	✓
Source Brake Contactor	—	—	✓
Dynamic Brake Connector - DB1	—	—	✓
EMI Filter	—	—	✓
Shielded Motor Cable	—	—	✓
Product Selection	**Page 4-59**	**Page 4-59**	**Page 4-70**

Bulletin 280D/281D ArmorStart Distributed Motor Controller — Safety Version

- On-Machine starting solution
- Full-voltage and reversing
- Horsepower range 0.5…10 Hp (0.37…7.5 kW)
- Robust IP67/NEMA Type 4 enclosure rating
- Quick disconnect connections for I/O, communications, motor, and three-phase power
- Gland plate entry: conduit entrance or ArmorConnect power media
- LED status indication
- DeviceNet communications
- Local logic technology using DeviceLogix
- Peer-to-peer communication (ZIP)
- Factory installed option:
  – Hand/Off/Auto (HOA) keypad configuration

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Options 4-59
Accessories..... 4-79
Specifications..... 4-61
Approx. Dimensions . 4-64

Standards Compliance

UL 508
CSA C22.2, No. 14
EN/IEC 60947-4
EN/IEC 60947-4-1
CE Marked per Low Voltage Directive 2006/95/EC and EMC Directive 2004/108/EC
CCC
ODVA for DeviceNet

Certifications

cULus (File No. E3125, Guides NLDX, NLDX7)

Description

The Bulletin 280/281 ArmorStart Distributed Motor Controller is an integrated, pre-engineered, starter for full-voltage and reversing applications. Its modular design offers simplicity in wiring using quick disconnects for the I/O, communications, and motor connection. Optional quick disconnects for control and three-phase power, fully integrates the plug-n-play solution. As standard, the ArmorStart offers four inputs and two outputs to be used with sensors and actuators. The ArmorStart Distributed Motor Controller offers as standard, a local at-motor disconnect means by incorporating the Bulletin 140M Motor Circuit Protector. This eliminates the need for additional components that would otherwise be required in each motor branch circuit. The ArmorStart Distributed Motor Controllers are listed as suitable for Group Motor installations.

ArmorStart Safety Version

The safety version of the ArmorStart provides a safety solution integrated into DeviceNet safety installations. The Bulletin 280/281 Safety ArmorStart achieves Category 4 functionality by using redundant contactors. The Safety ArmorStart offers quick disconnects via the gland plate to the 1732DS-IB8XOBV4 safety I/O module. The Bulletin 1732DS Guard Safety I/O inputs will monitor the status of the safety-rated contactors inside the ArmorStart. The Bulletin 1732DS Guard Safety I/O outputs provide 24V DC power to the ArmorStart.

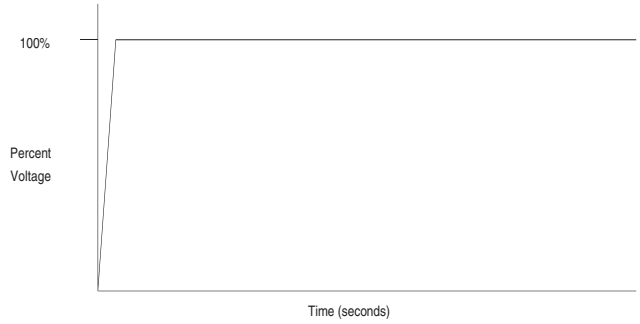
Note: The Bulletin 280/281 Safety ArmorStart is suitable for safety applications up to Safety Category 4 PLe (TÜV assessment per ISO 13849-1:2008). TÜV compliance letter is available upon request.

Note: For additional information regarding the 1732DS-IB8XOBV4 safety I/O module, see publication 1791DS-UM001*.

Mode of Operation

Full-Voltage Start

This method is used in applications requiring across-the-line starting. Full in-rush current and locked-rotor torque are realized. The ArmorStart Bulletin 280 offers full-voltage starting, and the Bulletin 281 offers full-voltage starting for reversing applications.



Overload Protection

The Bulletin 280/281 ArmorStart Distributed Motor Controller incorporates, as standard, electronic motor overload protection. This overload protection is accomplished electronically with an I^2t algorithm. The ArmorStart's overload protection is programmable via the communication network, providing the user with flexibility. The overload trip class can be selected for class 10, 15, or 20 protection. Ambient insensitivity is inherent in the electronic design of the overload.

Fault Diagnostics

Fault diagnostics capabilities built in the ArmorStart Distributed Motor Controller help you pinpoint a problem for easy troubleshooting and quick re-starting.

- Short Circuit
- Overload
- Phase Loss
- Control Power Loss
- Control Power Fuse Detection
- I/O Fault
- Output Power Fuse Detection
- Overtemperature
- Phase Imbalance
- DeviceNet Power Loss
- EEPROM Fault
- Hardware Fault

DeviceLogix - Local logic control

DeviceLogix provides local control over the device's discrete and network I/O. It consists of function blocks, inputs, outputs, and actual hardware data, including fault and status bits.

Motor Cable

A 3-meter unshielded, 4-conductor cordset is provided with every ArmorStart Distributed Motor Controller.

Factory-Installed Option

HOA Selector Keypad

The HOA Selector Keypad allows local start/stop control.

Catalog Number Explanation

Examples given in this section are for reference purposes. This basic explanation should not be used for product selection; not all combinations will produce a valid catalog number.

280	D	–	F	12S	–	10	C	–	CR	–	Option 1
a	*b*		*c*	*d*		*e*	*f*		*g*		*h*

a

Bulletin Number	
Code	Description
280	Full Voltage Starter
281	Reversing Starter

b

Communications	
Code	Description
D	DeviceNet™

c

Enclosure Type	
Code	Description
F	Type 4 (IP67)

d

Contactor Size/Control Voltage	
Code	Description
12S	24V DC
23S	

e

Short Circuit Protection (Motor Circuit Protector)	
Code	Description
10	10 A Rated Device
25	25 A Rated Device

f

Overload Selection Current Range	
Code	Description
B	0.5…2.5 A
C	1.1…5.5 A
D	3.2…16 A

h

Option 1	
Code	Description
3	Hand/Off/Auto Selector Keypad
3FR	Hand/Off/Auto Selector Keypad with Forward/Reverse

g

Control and 3-Phase Power Connections/Motor Cable Connection (CR: Conduit/Round Media) or (RR: Round/Round Media)				
Code		Description		
		Control Power‡	3-Phase Power	Motor Cable
CR	blank	Round Media (Male Receptacle)	Conduit Entrance	3 m, unshielded cordset male 90°
CR	W ∗	Round Media (Male Receptacle)	Conduit Entrance	No cable
RR	blank	Round Media (Male Receptacle)	Round Media (Male Receptacle)	3 m, unshielded cordset male 90°
RR	W ∗	Round Media (Male Receptacle)	Round Media (Male Receptacle)	No cable

∗ See Accessories on page 4-82 for extended motor cable lengths.
‡ Control power is provided by the Guard I/O Safety Module. Refer to accessories on page 4-79 for proper media selction.

Product Selection
DeviceNet Network Communications

Full-voltage starters — IP67/NEMA Type 4 with conduit entrance, Up to 460V AC

	kW		Hp			24V DC Control Voltage
Current Rating [A]	230V AC 50 Hz	400V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	Cat. No.
0.5…2.5	0.37	0.75	0.5	0.5	1	280D-F12S-10B-CR
1.1…5.5	1.1	2.2	1	1	3	280D-F12S-10C-CR
3.2…16	4	7.5	3	5	10	280D-F23S-25D-CR

Full-voltage starters — IP67/NEMA Type 4 with quick disconnects for ArmorConnect power media, Up to 460V AC

	kW		Hp			24V DC Control Voltage
Current Rating [A]	230V AC 50 Hz	400V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	Cat. No.
0.5…2.5	0.37	0.75	0.5	0.5	1	280D-F12S-10B-RR
1.1…5.5	1.1	2.2	1	1	3	280D-F12S-10C-RR
3.2…16	4	7.5	3	5	10	280D-F23S-25D-RR

Reversing starters — IP67/NEMA Type 4 with conduit entrance, Up to 460V AC

	kW		Hp			24V DC Control Voltage
Current Rating [A]	230V AC 50 Hz	400V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	Cat. No.
0.5…2.5	0.37	0.75	0.5	0.5	1	281D-F12S-10B-CR
1.1…5.5	1.1	2.2	1	1	3	281D-F12S-10C-CR
3.2…16	4	7.5	3	5	10	281D-F23S-25D-CR

Reversing starters — IP67/NEMA Type 4 with quick disconnects for ArmorConnect power media, Up to 460V AC

	kW		Hp			24V DC Control Voltage
Current Rating [A]	230V AC 50 Hz	400V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	Cat. No.
0.5…2.5	0.37	0.75	0.5	0.5	1	281D-F12S-10B-RR
1.1…5.5	1.1	2.2	1	1	3	281D-F12S-10C-RR
3.2…16	4	7.5	3	5	10	281D-F23S-25D-RR

Options – Factory Installed

Description		Cat. No. Modification
	Hand/Off/Auto Selector Keypad (Bulletin 280)	-3
	Hand/Off/Auto Selector Keypad with Forward/Reverse Function (Bulletin 281)	-3FR
	Supplied ArmorStart without motor cable	-CRW
	ArmorConnect Power Media Connectivity, ArmorStart supplied without motor cable	-RRW

ArmorStart Receptacle Pin Outs

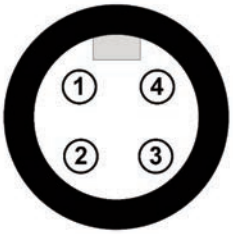
Receptacle Connections for Output, DeviceNet or ArmorPoint Version (M12)

Pin 1: PE
Pin 2: Return
Pin 3: Relay out

Receptacle Connections for Motor Connector - 3 Hp or less (M22)

Pin 1: T1 (black)
Pin 2: T2 (white)
Pin 3: T3 (red)
Pin 4: Ground (green/yellow)

Receptacle Connections for Motor Connector - 10 Hp or greater (M35)



Pin 1: T1 (black)
Pin 2: Ground (green/yellow)
Pin 3: T3 (red)
Pin 4: T2 (white)

Receptacle Connections for Safety Monitor Outputs to Bulletin 1732DS-* (SM1/SM2) (M12)

Pin 1: ArmorStart SM1 (brown)
Pin 2: ArmorStart SM2 (white)
Pin 3: Not used
Pin 4: Not used

Receptacle Connections for Safety (Bulletin 1732DS) Power (A1/A2) (M12)

Pin 1: ArmorStart A1 (brown)
Pin 2: ArmorStart P (white)
Pin 3: ArmorStart A2 (blue)
Pin 4: ArmorStart M (black)

Receptacle Connections for DeviceNet Connector

Pin 1: Drain (no connection)
Pin 2: +VDNET
Pin 3: -VDNET
Pin 4: CAN_H
Pin 5: CAN_L

Receptacle Connections for Input (M12)

Pin 1: +24V (A3 or DNET)
Pin 2: Input 0
Pin 3: Common
Pin 4: Input 1
Pin 5: NC (no connection)

Receptacle Connections for Incoming 3-phase Power - 10 A Short Circuit Protection (M22)

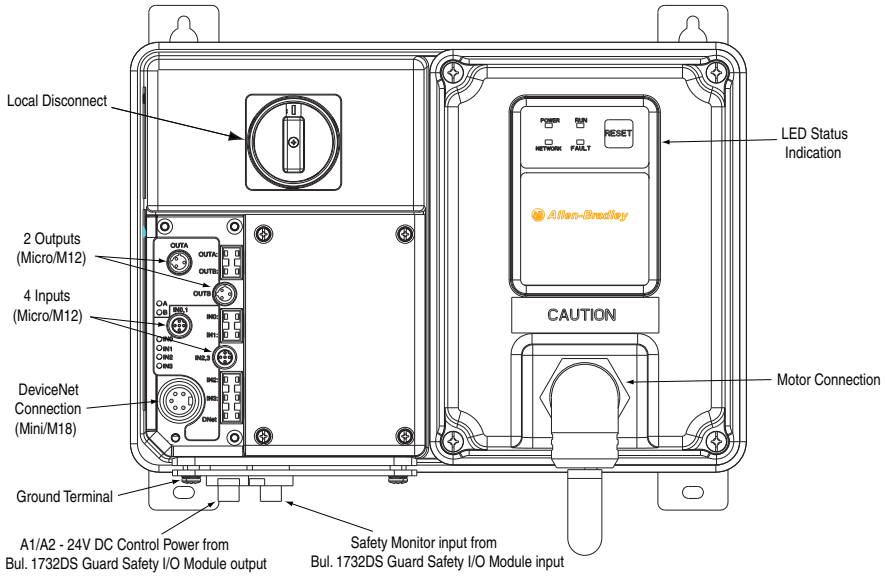
Pin 1: L1 (black)
Pin 2: L2 (white)
Pin 3: L3 (red)
Pin 4: Ground (green/yellow)

Receptacle Connections for Incoming 3-phase Power - 25 A Short Circuit Protection (M35)

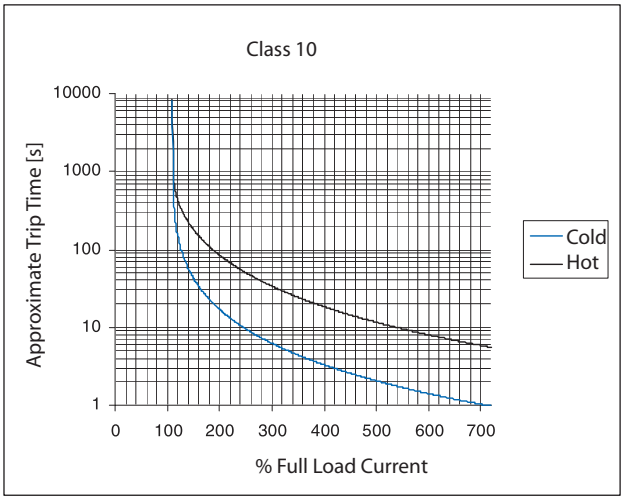
Pin 1: L1 (black)
Pin 2: Ground (green/yellow)
Pin 3: L3 (red)
Pin 4: L2 (white)

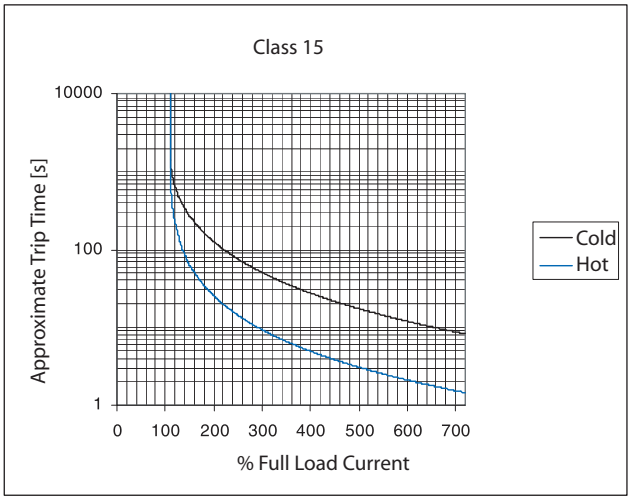
Connections

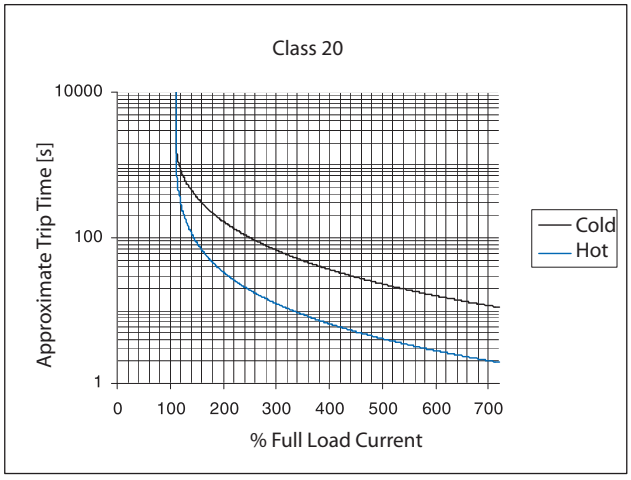
Bulletin 280D/281D Safety ArmorStart with DeviceNet Communications


Local Disconnect
LED Status Indication
2 Outputs (Micro/M12)
4 Inputs (Micro/M12)
DeviceNet Connection (Mini/M18)
Motor Connection
Ground Terminal
A1/A2 - 24V DC Control Power from Bul. 1732DS Guard Safety I/O Module output
Safety Monitor input from Bul. 1732DS Guard Safety I/O Module input
CAUTION
RESET

Overload Curves







Electrical Ratings			UL/NEMA	IEC
Power Circuit	Rated Operation Voltage		380Y/220…480Y/277V AC	380Y/220…480Y/277V AC
	Rate Insulation Voltage		600V	
	Rated Impulsed Voltage		4 kV	
	Dielectric Withstand		2200V AC	2500V AC
	Operating Frequency		50/60 Hz	
	Utilization Category		—	AC-3
	Protection Against Shock		—	IP2X
	Rated Operating Current Max.		280D/281D-___-10B-*	2.5 A
			280D/281D-___-10C-*	5.5 A
			280D/281D-___-10D-*	16 A
Control Circuit	Rated Operation Voltage		24V DC (+10%, -15%) A2 (should be grounded at voltage source)	
	Rate Insulation Voltage		250V	
	Rated Impulsed Voltage		—	4 kV
	Dielectric Withstand		1500V AC	2000V AC
	Overvoltage Category		—	III
	Operating Frequency		50/60 Hz	
Short Circuit Protection	SCPD Performance Type 1 Sym. Amps RMS @ 480Y/277V	**Current Rating**		
		0.5…2.5 A	65 kA	
		1.1…5.5 A		
		3.2…16 A	30 kA	
	SCPD List		Size per NFPA 70 (NEC) or NFPA 79 for Group Motor Applications	

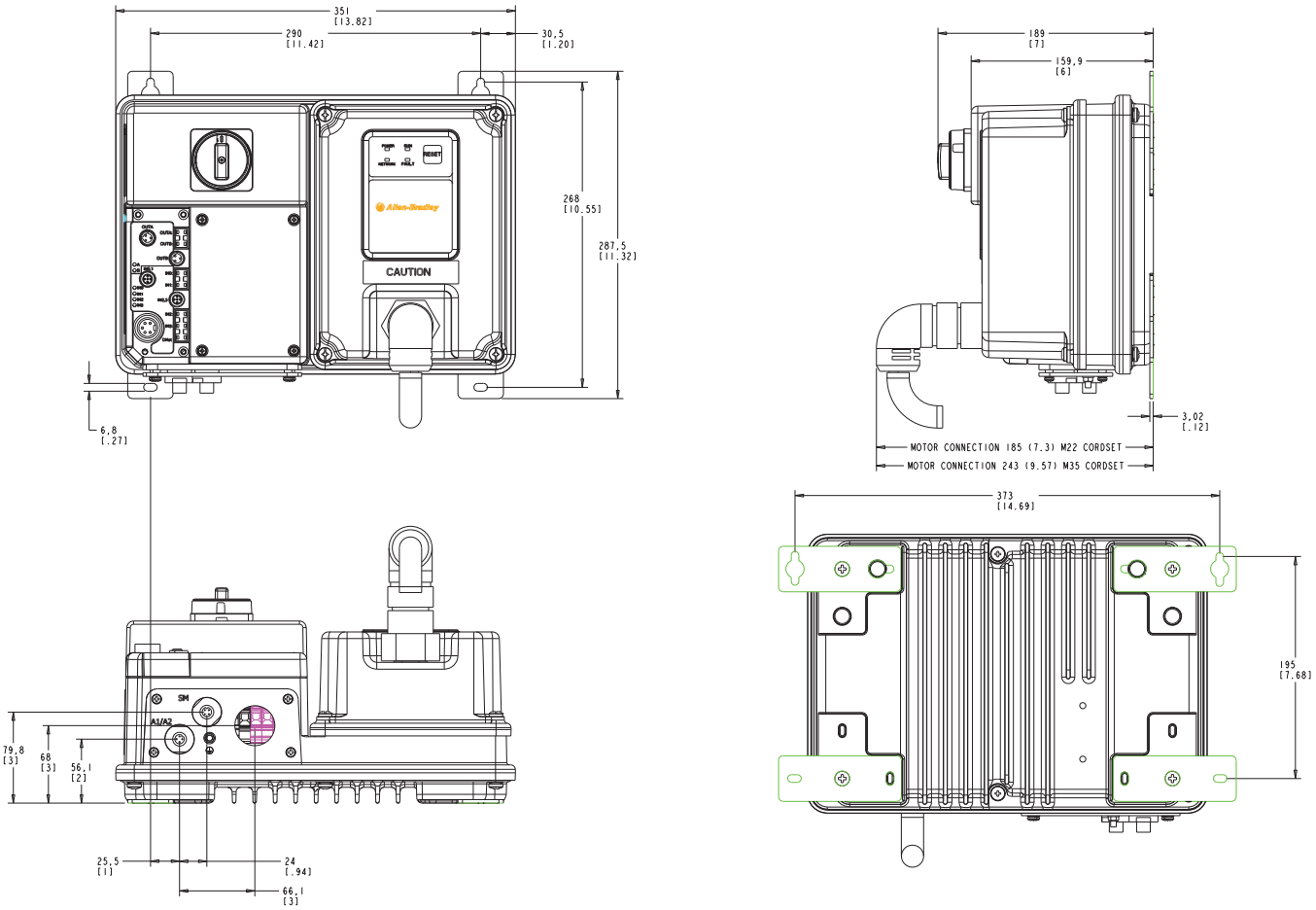
Power Requirements			
	Units	**Without HOA**	**With HOA**
Control Voltage	Volts	24V DC	
Contactor (Pick Up)	Amps	1.09	
Contactor (Hold In)	Amps	0.30	
Total Control Power (Pick Up)	VA (W)	(26 W)	
Total Control Power (Hold In)	VA (W)	(7.2 W)	
External Devices powered by Control Voltage			
Outputs (2) (1 A max. each)	Amps	2	2
Total Control (Pick Up) with max outputs	VA (W)	(65 W)	(73 W)
Total Control (Hold In) with max outputs	VA (W)	(50 W)	(58 W)

Input Ratings	Rated Operation Voltage	24V DC	
	Input On-State Voltage Range	10…26V DC	
	Input On-State Current	3.0 mA @ 10V DC	
		7.2 mA @ 24V DC	
	Input Off-State Voltage Range	0…5V DC	
	Input Off-State Current	<1.5 mA	
	Input Filter — Software Selectable		
	Off to On	Settable from 0…64 ms in 1 ms increments	
	On to Off	Settable from 0…64 ms in 1 ms increments	
	Input Compatibility	N/A	IEC 1+
	Number of Inputs	4	
	Sensor Source		
	Voltage Status Only	11…25V DC from DeviceNet	
	Current Available	50 mA max. per input, 200 mA total	
Output Ratings (Sourced from Control Circuit)	Rated Operation Voltage	240V AC/30V DC	240V AC/30V DC
	Rate Insulation Voltage	250V	250V
	Dielectric Withstand	1500V AC	2000V AC
	Operating Frequency	50/60 Hz	50/60 Hz
	Type of Control Circuit	Electromechanical relay	
	Type of Current	AC/DC	
	Conventional Thermal Current I_{th}	Total of both outputs ≤ 2 A	
	Type of Contacts	Normally open (N.O.)	
	Number of Contacts	2	

		UL/NEMA	IEC
Environmental	Operating Temperature Range	-20…+40 °C (-4…+104 °F)	
	Storage and Transportation Temperature Range	–25….+85 °C (–13…+185 °F)	
	Altitude	2000 m	
	Humidity	5…95% (non-condensing)	
	Pollution Degree	3	
	Enclosure Ratings	NEMA 4/12/13	IP67
	Approximate Shipping Weight	6.8 kg (15 lb)	
Mechanical	**Resistance to Shock**		
	Operational	15 G	
	Non-Operational	30 G	
	Resistance to Vibration		
	Operational	1 G, 0.15 mm (0.006 in.) displacement	
	Non-Operational	2.5 G, 0.38 mm (0.015 in.) displacement	
	Power and Ground Terminals		
	Wire Size	Primary terminal: (#16 …#10 AWG) Secondary terminal: (#18 …#10 AWG)	Primary terminal: 1.5…5.3 mm² Secondary terminal: 0.8…5.3 mm²
	Tightening Torque	Primary terminal: 10.8 lb•in Secondary terminal: 4.5 lb•in	Primary Terminal: 1.2 N•m Secondary terminal: 0.5 N•m
	Wire Strip Length	0.35 in. (9 mm)	
	Disconnect Lock Out	Maximum of 5/16 in. (8 mm) lock shackle or hasp. The hasp should not exceed 5/16 in. (8 mm) when closed, or damage will occur to the disconnect guard.	
Other Rating	**EMC Emission Levels**		
	Conducted Radio Frequency Emissions	Class A	
	Radiated Emissions	Class A	
	EMC Immunity Levels		
	Electrostatic Discharge	4 kV contact and 8 kV Air	
	Radio Frequency Electromagnetic Field	10V/m	
	Fast Transient	2 kV	
	Surge Transient	1 kV $_{L-L}$, 2 kV $_{L-N}$ (earth)	
	Overload Characteristics		
	Overload Current Range	280D/281D-___-10B-*	0.5…2.5 A
		280D/281D-___-10C-*	1.1…5.5 A
		280D/281D-___-10D-*	3.2…16 A
	Trip Classes	10, 15, 20	
	Trip Rating	120% of FLC setting	
	Number of poles	3	
	DeviceNet Specifications		
	DeviceNet Supply Voltage Rating	Range 11…25V DC, 24V DC nominal	
	DeviceNet Input Current	167 mA @ 24V DC - 4.0 W	
		364 mA @ 11V DC - 4.0 W	
	External Devices powered by DeviceNet	Sensors inputs 4 x 50 mA - total 200 mA	
	Total w/max Sensor Inputs (4)	367 mA @ 24V DC - 8.8 W	
	DeviceNet Input Current Surge	15 A for 250 µs	
	DeviceNet Communications		
	Baud Rates	125, 250, 500 kbps	
	Distance Maximum	500 m (1630 ft) @ 125 kbps	
		200 m (656 ft) @ 250 kbps	
		100 m (328 ft) @ 500 kbps	
	Certifications	cULus (File No. E3125, Guides NLDX, NLDX7) UL 508 CSA C22.2, No. 14 EN/IEC 60947-4, EN/IEC 60947-4-1 CE Marked per Low Voltage Directive 2006/95/EC and EMC Directive 2004/108/ECC	

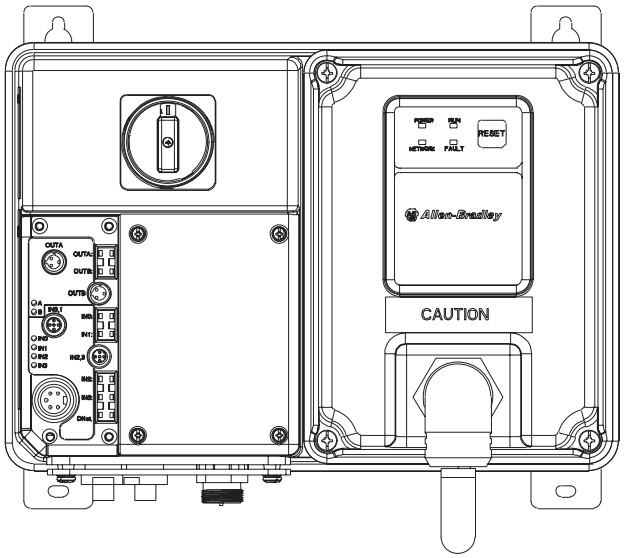
Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.

Dimensions for Bulletin 280D Safety Product with Conduit Entrance

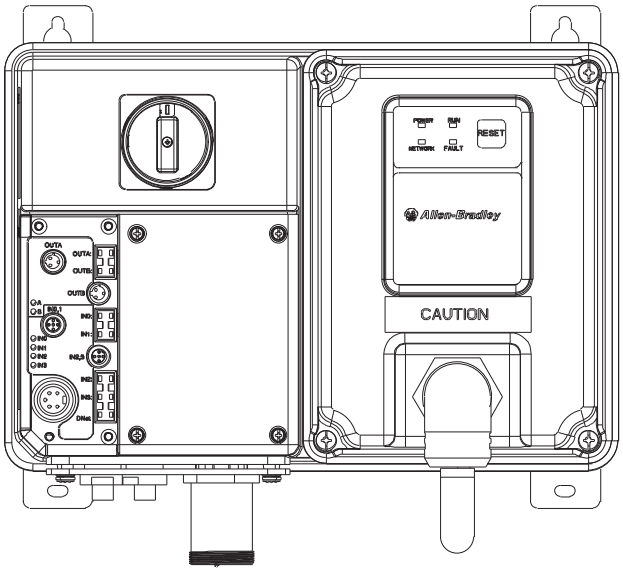


Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.

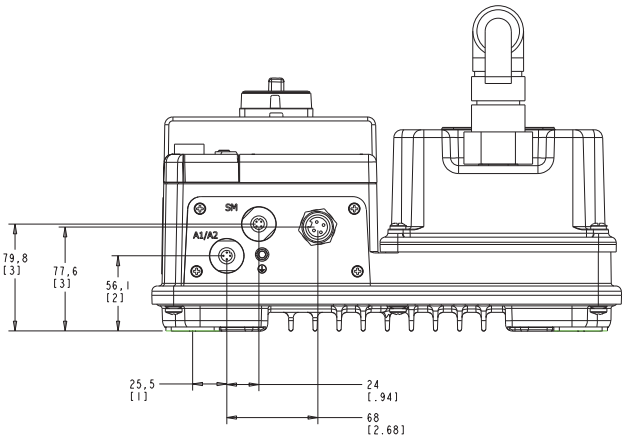
Dimensions for Bulletin 280D Safety with ArmorConnect Connectivity

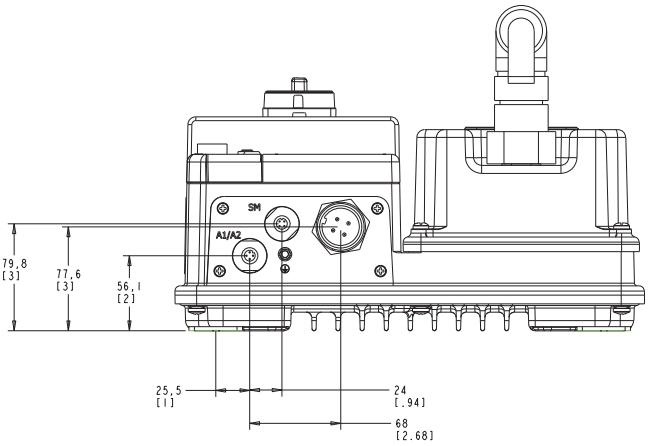


10 A short circuit protection rating



25 A short circuit protection rating

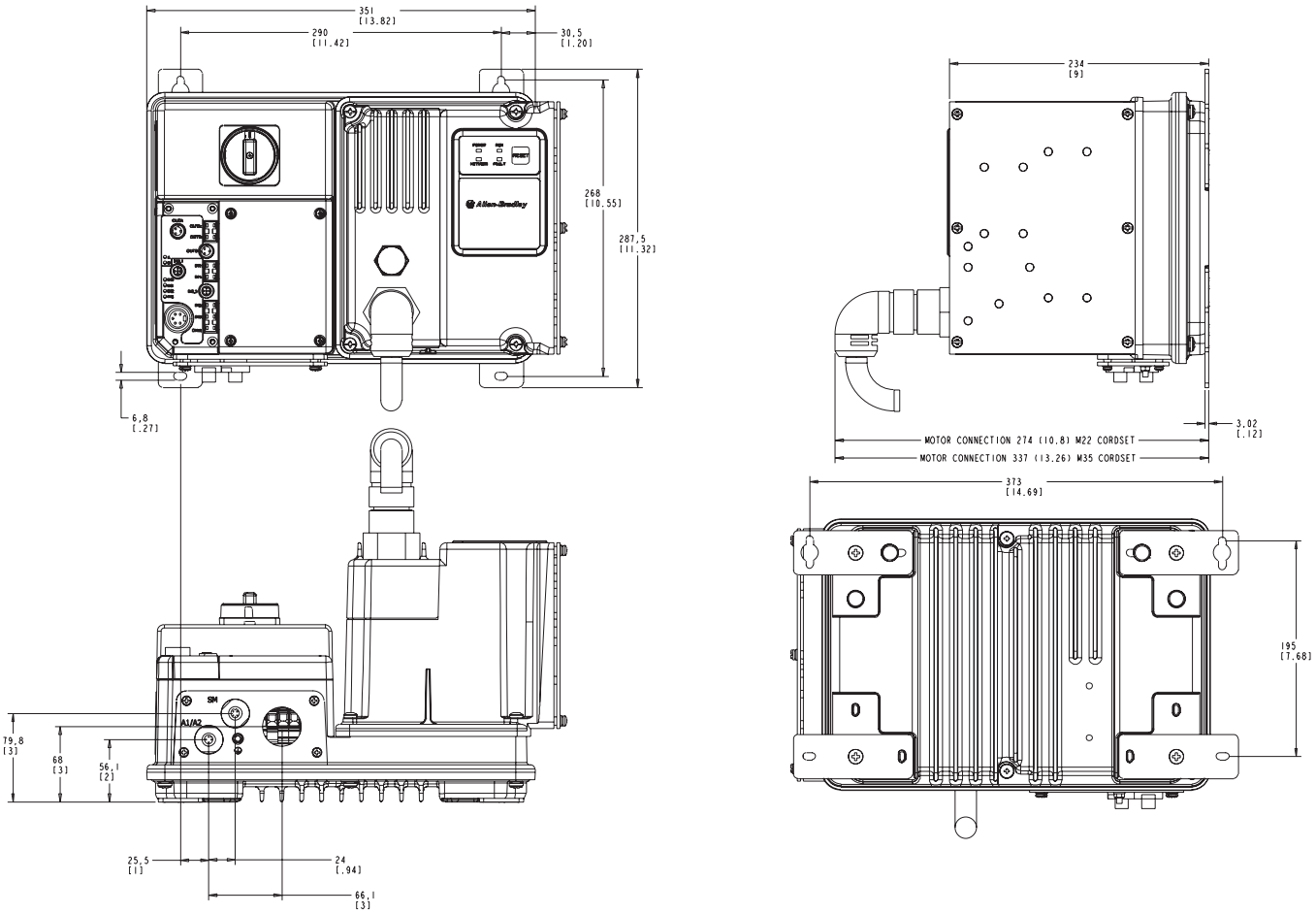




4

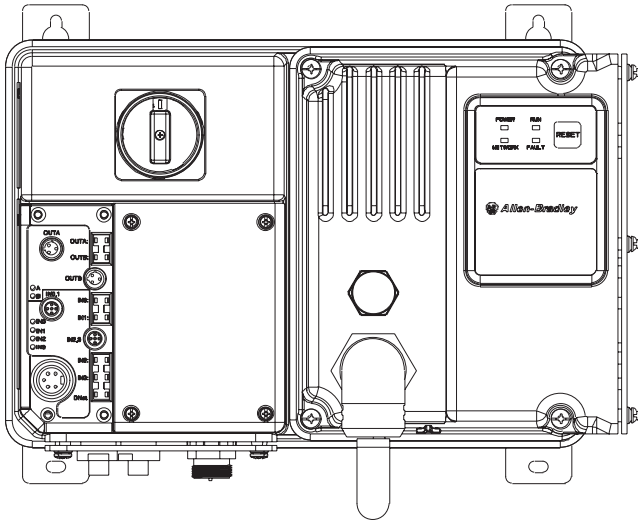
Dimensions for Bulletin 281D Safety Product with Conduit Entrance

Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.

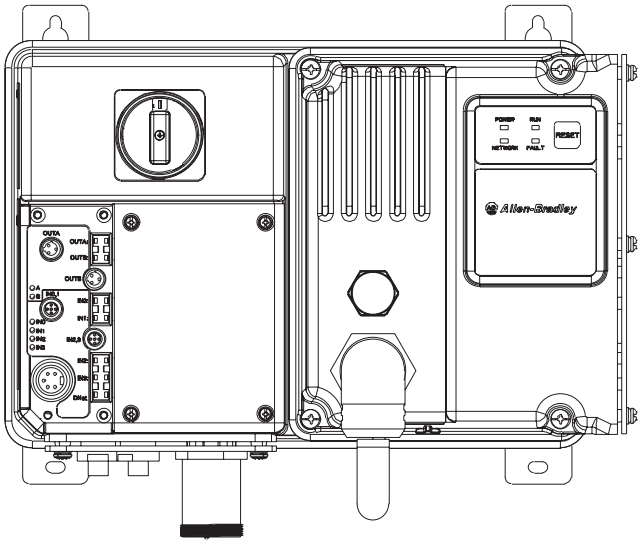


Dimensions for Bulletin 281D Safety Product with ArmorConnect Connectivity

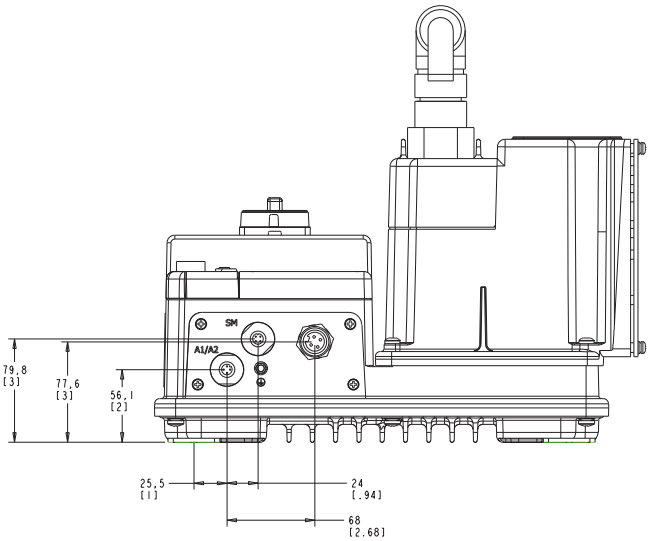
Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.

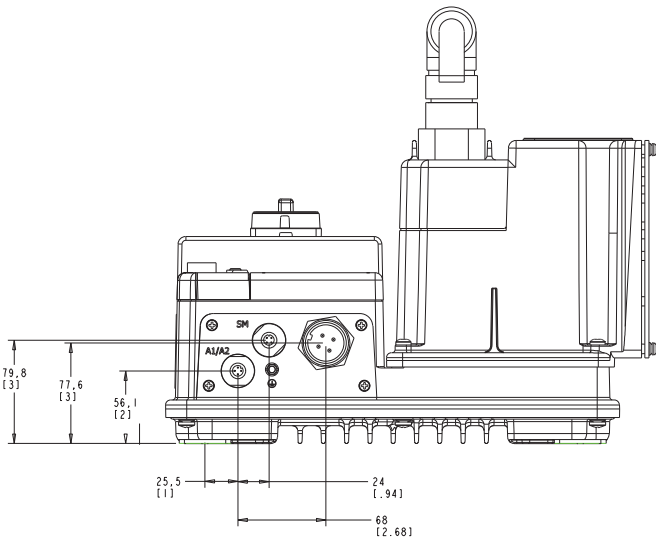


10 A short circuit protection rating



25 A short circuit protection rating





Bulletin 284D ArmorStart Distributed Motor Controller - Safety Version

- On-Machine starting solution
- Variable frequency AC drive using PowerFlex® technology
- Horsepower range 0.5…5 Hp (0.4…3.3 kW)
- Robust IP67/NEMA Type 4 enclosure rating
- Quick disconnect connections for I/O, communications, motor, and three-phase power
- LED status indication
- DeviceNet communications
- Local logic control via DeviceLogix technology
- Peer-to-peer communications (ZIP)
- Factory-installed options:
  - EMI filter
  - Hand/Off/Auto (HOA) keypad configuration
  - Shielded motor cable
  - Output contactor

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Standards Compliance

UL 508C
CSA C22.2, No. 14
EN/IEC 60947-4-2, EN 50178, EN 61800-3
CE Marked per Low Voltage Directive 2006/95/EC and EMC Directive 2004/108/EC
CCC

Certifications

cULus (File No. E207834, Guide NMMS, NMMS7)

4

Description

The Bulletin 284 ArmorStart Distributed Motor Controller is an integrated, pre-engineered, starter for variable frequency AC drive applications. Its modular design offers simplicity in wiring using quick disconnects for the I/O, communications, and motor connection. Optional quick disconnects for control and three-phase power, fully integrates the plug-n-play solution. As standard, the ArmorStart offers four inputs and two outputs to be used with sensors and actuators. The ArmorStart Distributed Motor Controller offers, as standard, a local at-motor disconnect means by incorporating the Bulletin 140M Motor Circuit Protector. This eliminates the need for additional components that would otherwise be required in each motor branch circuit. The ArmorStart Distributed Motor Controllers are listed as suitable for Group Motor installations.

ArmorStart Safety Version

The safety version of the ArmorStart provides a safety solution integrated into DeviceNet safety installations. The Bulletin 284 Safety ArmorStart achieves Category 4 functionality by using redundant contactors. The Safety ArmorStart offers quick disconnects via the gland plate to the 1732DS-IB8XOBV4 safety I/O module. The Bulletin 1732DS Guard Safety I/O inputs will monitor the status of the safety-rated contactors inside the ArmorStart. The Bulletin 1732DS Guard Safety I/O outputs provide 24V DC power to the ArmorStart.

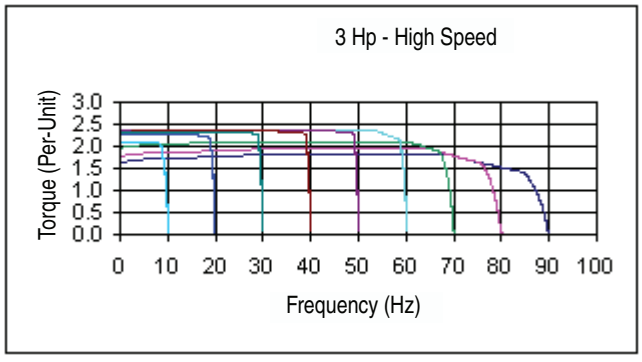
Note: The Bulletin 284 Safety ArmorStart is suitable for safety applications up to Safety Category 4 PLe (TÜV assessment per ISO 13849-1:2008). TÜV compliance letter is available upon request.

Note: For additional information regarding the 1732DS-IB8XOBV4 safety I/O module, see publication 1791DS-UM001*.

Mode of Operation

Sensorless Vector Control (SVC)

Sensorless vector control provides exceptional speed regulation and very high levels of torque across the entire speed range of the drive.



- The Autotune feature allows the Bulletin 284 (SVC) to adapt to individual motor characteristics.
- Timer, Counter, Basic Logic and StepLogic™ functions can reduce hardware design costs and simplify control schemes.
- Develops high torque over a wide speed range and adapts to individual motor characteristics.

Overload Protection

The Bulletin 284 ArmorStart Distributed Motor Controller incorporates, as standard, electronic motor overload protection. This overload protection is accomplished electronically with an I^2t algorithm. The ArmorStart's overload protection is programmable via the communication network providing the user with flexibility. The overload trip class allows for class 10 overload protection. Ambient insensitivity is inherent in the electronic design of the overload.

Fault Diagnostics

Fault diagnostics capabilities built into the Bulletin 284 ArmorStart Distributed Motor Controller help you pinpoint a problem for easy troubleshooting and quick re-starting.

- Short Circuit
- Overload
- Phase Short
- Ground Fault
- Stall
- Control Power Loss
- Control Power Fuse Protection
- I/O Fault
- Overcurrent
- Brake Fuse Protection
- Overtemperature
- Output Fuse Protection
- DeviceNet Power Loss
- Internal Communication Fault
- DC Bus Fault
- EEPROM Fault
- Hardware Fault
- Restart Retries
- Miscellaneous Fault

Motor Cable

With every Bulletin 284 ArmorStart Distributed Motor Controller, a 3–meter unshielded 4-conductor cordset is provided with each unit as standard. If the optional EMI filter is selected, a 3–meter shielded 4-conductor cordset is provided as standard.

Local Logic via DeviceLogix

Provides local control over the device's discrete and network I/O. DeviceLogix consists of function blocks, inputs, outputs, and actual hardware data, including fault and status bits.

Source Brake Contactor

An internal contactor is used to switch an electromechanical motor brake On/Off. The motor brake is powered from the line power circuit. The configuration of the R1 relay controls the function of the brake. A customer accessible 3 A fuse is provided to protect the brake cable. Included as standard, is a 3-meter 3-pin cordset for connection to the motor brake.

IP67 Dynamic Brake Connector

The IP67 Dynamic Brake Resistor design offers simplicity in wiring and installation. The DB1 option must be selected in order to have the quick disconnect connectivity. See accessories on page 4-85 for available IP67 Dynamic Brake Resistors.

Factory-Installed Options

HOA Selector Keypad with Jog Function

The HOA Selector Keypad with Jog Function allows local start/stop control with capabilities to JOG and to Forward/Reverse motor direction.

EMI Filter

The EMI Filter is required to be CE compliant. When selected, a 3–meter shielded 4–conductor motor cordset is provided as standard. This is only available with sensorless vector control.

Shielded Motor Cable

A 3-meter shielded 4-conductor cordset is provided instead of the 3-meter unshielded 4-conductor cordset, when the EMI Filter is selected.

Catalog Number Explanation

Examples given in this section are for reference purposes. This basic explanation should not be used for product selection; not all combinations will produce a valid catalog number.

284	D	–	F	V	D2P3	S	–	10	–	CR	–	Option 1	–	Option 2	–	Option 3
a	*b*		*c*	*d*	*e*	*f*		*g*		*h*		*i*		*j*		*k*

a

Bulletin Number	
Code	Description
284	VFD Starter

b

Communications	
Code	Description
D	DeviceNet

c

Enclosure Type	
Code	Description
F	Type 4 (IP67)

d

Torque Performance Mode	
Code	Description
V	Sensorless Vector Control and Volts per Hertz

e

Output Current	
Code	Description
D1P4	1.4 A, 0.4 kW, 0.5 Hp
D2P3	2.3 A, 0.75 kW, 1.0 Hp
D4P0	4.0 A, 1.5 kW, 2.0 Hp
D6P0	6.0 A, 2.2 kW, 3.0 Hp
D7P6	7.6 A, 3.3 kW, 5.0 Hp

f

Control Voltage	
Code	Description
S	24V DC

g

Short Circuit Protection (Motor Circuit Protector)	
Code	Description
10	10 A Rated Device
25	25 A Rated Device

i

Option 1	
Code	Description
3	Hand/Off/Auto Selector Keypad with Jog Function

j

Option 2	
Code	Description
SB W ∗	No Source Brake contactor cable

k

Option 3	
Code	Description
EMI	EMI Filter

h

Control and 3-Phase Power Connections / Motor Cable Connection (CR: Conduit/Round Media) or (RR: Round/Round Media)				
Code		Description		
		Control Power‡	3-Phase Power	Motor Cable
CR	blank	Round Media (Male Receptacle)	Conduit Entrance	3 m, unshielded cordset male 90°
CR	N	Round Media (Male Receptacle)	Conduit Entrance	3 m, shielded cordset male 90°
CR	W ∗	Round Media (Male Receptacle)	Conduit Entrance	No cable
RR	blank	Round Media (Male Receptacle)	Round Media (Male Receptacle)	3 m, unshielded cordset male 90°
RR	N	Round Media (Male Receptacle)	Round Media (Male Receptacle)	3 m, shielded cordset male 90°
RR	W ∗	Round Media (Male Receptacle)	Round Media (Male Receptacle)	No cable

∗ See Accessories on page 4-82 for extended motor and brake cable lengths.
‡ Control power is provided by the Guard I/O Safety Module. Refer to accessories on page 4-79 for proper media selction.

Product Selection

DeviceNet Network Communication

IP67/NEMA Type 4 with conduit entrance, Sensorless Vector Control, and Volts per Hertz torque performance, Up to 480V AC

Input Voltage	3-Phase kW Rating	3-Phase Hp Rating	Output Current [A]	24V DC Control Voltage Cat. No.
380…480V, 50/60 Hz 3-Phase	0.4	0.5	1.4	284D-FVD1P4S-10-CR-DB1-SB
	0.75	1	2.3	284D-FVD2P3S-10-CR-DB1-SB
	1.5	2	4	284D-FVD4P0S-10-CR-DB1-SB
	2.2	3	6	284D-FVD6P0S-25-CR-DB1-SB
	3	5	7.6	284D-FVD7P6S-25-CR-DB1-SB

IP67/NEMA Type 4 with quick disconnects for ArmorConnect power media, Sensorless Vector Control, and Volts per Hertz torque performance, Up to 480V AC

Input Voltage	3-Phase kW Rating	3-Phase Hp Rating	Output Current [A]	24V DC Control Voltage Cat. No.
380…480V, 50/60 Hz 3-Phase	0.4	0.5	1.4	284D-FVD1P4S-10-RR-DB1-SB
	0.75	1	2.3	284D-FVD2P3S-10-RR-DB1-SB
	1.5	2	4	284D-FVD4P0S-10-RR-DB1-SB
	2.2	3	6	284D-FVD6P0S-25-RR-DB1-SB
	3	5	7.6	284D-FVD7P6S-25-RR-DB1-SB

Options – Factory Installed

Description		Cat. No. Modification
	Hand/Off/Auto Selector and Jog Keypad	-3
	EMI Filter	-EMI
	Shielded motor cable	-CRN
	Supplied without motor cable	-CRW
	Source brake supplied with cable	-SB
	Source brake supplied without cable	-SBW
	Dynamic Brake Connector (IP67 brake)	-DB1
	ArmorConnect Power Media Connectivity, ArmorStart supplied with shielded motor cable	-RRN
	ArmorConnect Power Media Connectivity, ArmorStart supplied without motor cable	-RRW

ArmorStart Receptacle Pin Outs

Receptacle Connections for DeviceNet Connector

Pin 1: Drain (no connection)
Pin 2: +VDNET
Pin 3: -VDNET
Pin 4: CAN_H
Pin 5: CAN_L

Receptacle Connections for Input (M12)

Pin 1: +24V (A3 or DNET)
Pin 2: Input 0
Pin 3: Common
Pin 4: Input 1
Pin 5: NC (no connection)

Receptacle Connections for Output, DeviceNet or ArmorPoint Version (M12)

Pin 1: PE
Pin 2: Return
Pin 3: Relay out

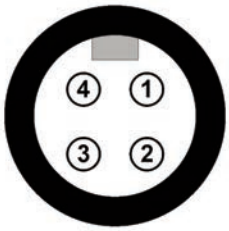
Receptacle Connections for Dynamic Brake (M22)

Pin 1: GND (green/yellow)
Pin 2: BR+ (black)
Pin 3: BR- (white)

Receptacle Connections for Source or Control Brake

Pin 1: L1 (black)
Pin 2: GND (green/yellow)
Pin 3: L2 (white)

Receptacle Connections for Motor Connector (M22)



Pin 1: T1 (black)
Pin 2: T2 (white)
Pin 3: T3 (red)
Pin 4: Ground (green/yellow)

Receptacle Connections for Incoming 3-phase Power - 10 A Short Circuit Protection (M22)

Pin 1: L1 (black)
Pin 2: L2 (white)
Pin 3: L3 (red)
Pin 4: Ground (green/yellow)

Receptacle Connections for Incoming 3-phase Power - 25 A Short Circuit Protection (M35)

Pin 1: L1 (black)
Pin 2: Ground (green/yellow)
Pin 3: L3 (red)
Pin 4: L2 (white)

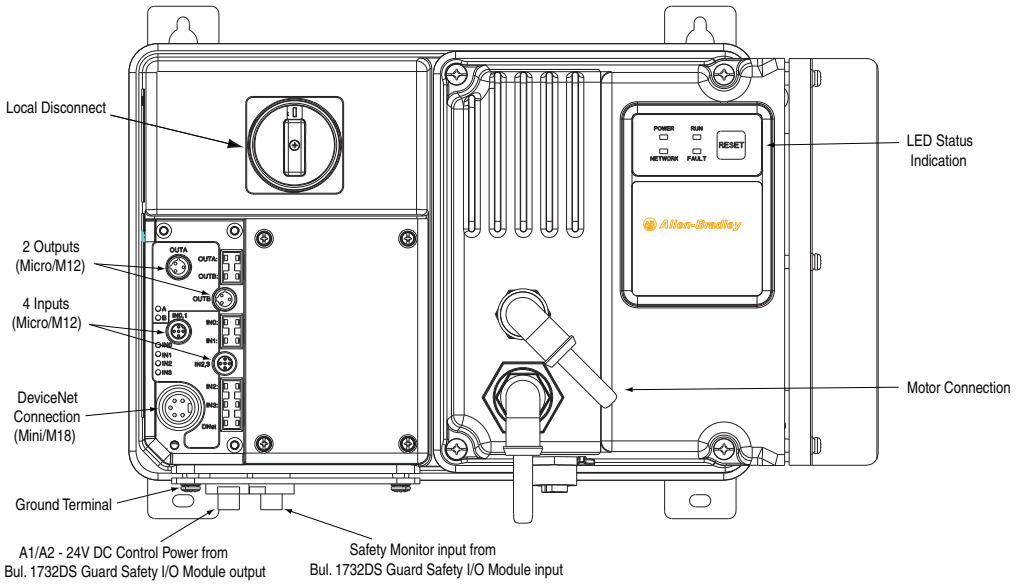
Receptacle Connections for Safety Monitor Outputs to Bulletin 1732DS-* (SM1/SM2) (M12)

Pin 1: ArmorStart SM1 (brown)
Pin 2: ArmorStart SM2 (white)
Pin 3: Not used
Pin 4: Not used

Receptacle Connections for Safety (Bulletin 1732DS) Power (A1/A2) (M12)

Pin 1: ArmorStart A1 (brown)
Pin 2: ArmorStart P (white)
Pin 3: ArmorStart A2 (blue)
Pin 4: ArmorStart M (black)

Bulletin 284D Safety ArmorStart with DeviceNet Communications



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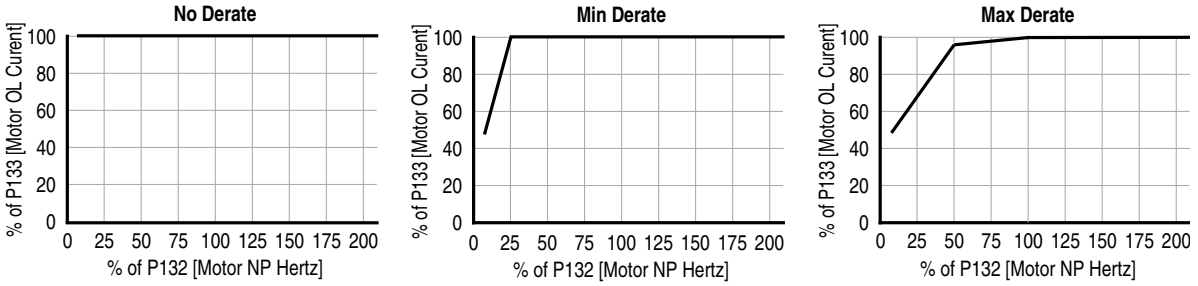
Motor Overload Trip Curves

Motor overload current parameter provides class 10 overload protection. Ambient insensitivity is inherent in the electronic design of the overload.



Electrical Ratings		UL/NEMA			IEC		
Power Circuit	Rated Operation Voltage	200…575V			200…500V		
	Rate Insulation Voltage	600V			600V		
	Rated Impulsed Voltage	6 kV			6 kV		
	Dielectric Withstand	2200V AC			2500V AC		
	Operating Frequency	50/60 Hz			50/60 Hz		
	Utilization Category	N/A			AC-3		
	Protection Against Shock	N/A			IP2X		
Control Circuit	Rated Operation Voltage	24V DC (+10%, -15%) A2 (should be grounded at voltage source)					
	Rate Insulation Voltage	250V			250V		
	Rated Impulsed Voltage	—			4 kV		
	Dielectric Withstand	1500V AC			2000V AC		
	Overvoltage Category	—			III		
	Operating Frequency	50/60 Hz					
Short Circuit Protection	SCPD Performance Type 1	**Current Rating**	**Voltage**	480Y/277V	480/480V	600Y/347V	600V
		10 A	Sym. Amps RMS	65 kA	65 kA	30 kA	30 kA
		25 A		30 kA	30 kA	30 kA	30 kA
	SCPD List	Size per NFPA 70 (NEC) or NFPA 79 for Group Motor Applications					

		UL/NEMA	IEC
Environmental	Operating Temperature Range	-20…+40 °C (-4…+104 °F)	
	Storage and Transportation Temperature Range	–25….+85 °C (–13…+185 °F)	
	Altitude	1000 m	
	Humidity	5…95% (non-condensing)	
	Pollution Degree	3	
	Enclosure Ratings	NEMA 4/12/13	IP67
	Approximate Shipping Weight	13.6 kg (30 lb)	
Mechanical	**Resistance to Shock**		
	Operational	15 G	
	Non-Operational	30 G	
	Resistance to Vibration		
	Operational	1 G, 0.15 mm (0.006 in.) displacement	
	Non-Operational	2.5 G, 0.38 mm (0.015 in.) displacement	
	Wire Size	Primary/Secondary terminal: (16 …10 AWG)	Primary/Secondary terminal: 1.5…4.0 mm^2
	Tightening Torque	Primary terminal: 10.8 lb•in Secondary terminal: 4.5 lb•in	Primary terminal: (1.2 N•m) Secondary terminal: (0.5 N•m)
	Wire Strip Length	0.35 in. (9 mm)	
	Control and Safety Monitor Inputs		
	Wire Size	(18…10 AWG)	1.0…4.0 mm^2
	Tightening Torque	6.2 lb•in	0.7 N•m
	Wire Strip Length	0.35 in. (9 mm)	
	Disconnect Lock Out	Maximum of 5/16 in. (8 mm) lock shackle or hasp. The hasp should not exceed 5/16 in. (8 mm) when closed, or damage will occur to disconnect guard.	
EMC Emission Levels	Conducted Radio Frequency Emissions	10V rms Communication cables 10V rms (PE) 150 KHz…80 MHz	
	Radiated Emissions	Class A	
EMC Immunity Levels	Electrostatic Discharge	4 kV contact and 8 kV Air	
	Radio Frequency Electromagnetic Field	10V/m, 80 KHz…1 GHz 3V/m, 1.4 GHz…2.0 GHz 1V/m, 2.0 GHz…2.7 GHz	
	Fast Transient	2 kV (Power) 2 kV (PE) 1 kV (Communications and control)	
	Surge Transient	1 kV (12) $_{L-L}$, 2 kV (2) $_{L-N}$ (earth)	
Standards Compliance		UL 508C; CSA C22.2, No. 14; EN50178; EN61800-3; EN/IEC 60947-4-2; CE Marked per Low Voltage 2006/95/EC; EMC Directive 2004/108/EC; CCC; ODVA for DeviceNet	
Certifications		cULus (File No. E207834, Guide NMMS, NMMS7)	

		UL/NEMA	IEC
Input Ratings	Rated Operation Voltage	24V DC	
	Input On-State Voltage Range	10…26V DC	
	Input On-State Current	3.0 mA @ 10V DC	
		7.2 mA @ 24V DC	
	Input Off-State Voltage Range	0…5V DC	
	Input Off-State Current	<1.5 mA	
	Input Filter — Software Selectable		
	Off to On	Settable from 0…64 ms in 1 ms increments	
	On to Off	Settable from 0…64 ms in 1 ms increments	
	Input Compatibility	N/A	IEC 1+
	Number of Inputs	4	
	Sensor Source		
	Voltage Status Only	11…25V DC from DeviceNet	
	Current Available	50 mA max. per input, 200 mA total	
Output Ratings Sourced from control circuit - A1/A2	Rated Operation Voltage	240V AC/30V DC	240V AC/30V DC
	Rate Insulation Voltage	250V	250V
	Dielectric Withstand	1500V AC	2000V AC
	Operating Frequency	50/60 Hz	
	Type of Control Circuit	Electromechanical relay	
	Type of Current	AC/DC	
	Conventional Thermal Current I_{th}	Total of both outputs ≤ 2 A	
	Type of Contacts	Normally open (N.O.)	
	Number of Contacts	2	
DeviceNet Specifications	DeviceNet Supply Voltage Rating	Range 11…25V DC, 24V DC nominal	
	DeviceNet Input Current	167 mA @ 24V DC - 4.0 W	
	DeviceNet Input Current	364 mA @ 11V DC - 4.0 W	
	External Devices powered by DeviceNet	Sensors inputs 4 x 50 mA - total 200 mA	
	Total w/max Sensor Inputs (4)	367 mA @ 24V DC - 8.8 W	
	DeviceNet Input Current Surge	15 A for 250 µs	
DeviceNet Communications	Baud Rates	125, 250, 500 kbps	
	Distance Maximum	500 m (1630 ft) @ 125 kbps	
	Distance Maximum	200 m (656 ft) @ 250 kbps	
	Distance Maximum	100 m (328 ft) @ 500 kbps	

Drive Characteristics	Sensorless Vector Control
Maximum Hp (kW)/Input Voltage	5 Hp (3.3 kW)/480V AC
Overload Capacity	150% for 60 seconds, 200% for 3 seconds
Output Frequency (programmable)	0…400 Hz
Efficiency (typical)	97.5%
Preset Speeds	8
Carrier Frequency	2…16 kHz
Skip Frequency	✓
Process Control Loop	✓ (PID)
StepLogic Functionality	✓
Timer/Counter Functions	✓

Drive Ratings — VFD Output Current vs. Input Current

Line Voltage	Frequency [Hz]	3-Phase kW Rating	3-Phase Hp Rating	Output Current [A] Sensorless Vector Control	Input Current [A] Sensorless Vector Control
380	50	0.4	—	1.4	2.15
		0.75	—	2.3	3.80
		1.5	—	4.0	6.40
		2.2	—	6.0	9.00
		3.0	—	7.6	12.40
460	60	—	0.5	1.4	1.85
		—	1	2.3	3.45
		—	2	4.0	5.57
		—	3	6.0	8.20
		—	5	7.6	12.5

Protective Specifications — Sensorless Vector Control	
Motor Protection	I^2t overload protection — 150% for 60 seconds, 200% for 3 seconds (provides Class 10 protection)
Overcurrent	200% hardware limit, 300% instantaneous fault
Overvoltage	380…460V AC Input — Trip occurs @ 810V DC bus voltage (equivalent to 575V AC incoming line)
Undervoltage	380…480V AC Input — Trip occurs @ 390V DC bus voltage (equivalent to 275V AC incoming line)
Faultless Power Ride Through	100 milliseconds

Control Specifications — Sensorless Vector Control	
Carrier Frequency	2…16 kHz drive rating based on 4 kHz
Frequency Accuracy **Digital Input**	within ±0.05% of set output frequency
Speed Regulation (open loop with slip compensation)	±1% of base speed across a 60:1 speed range
Stop Modes	Multiple programmable stop modes including: Ramp, Coast, DC-Brake, Ramp-to-Hold, and S Curve
Acceleration/Deceleration	Two independently programmable acceleration and deceleration times: each time may be programmed from 0…600 seconds in 0.1 second increments
Intermittent Overload	150% overload capability for up to 1 minute, 200% overload capability for up to 3 seconds
Electronic Motor Overload Protection	Class 10 protection with speed sensitive response

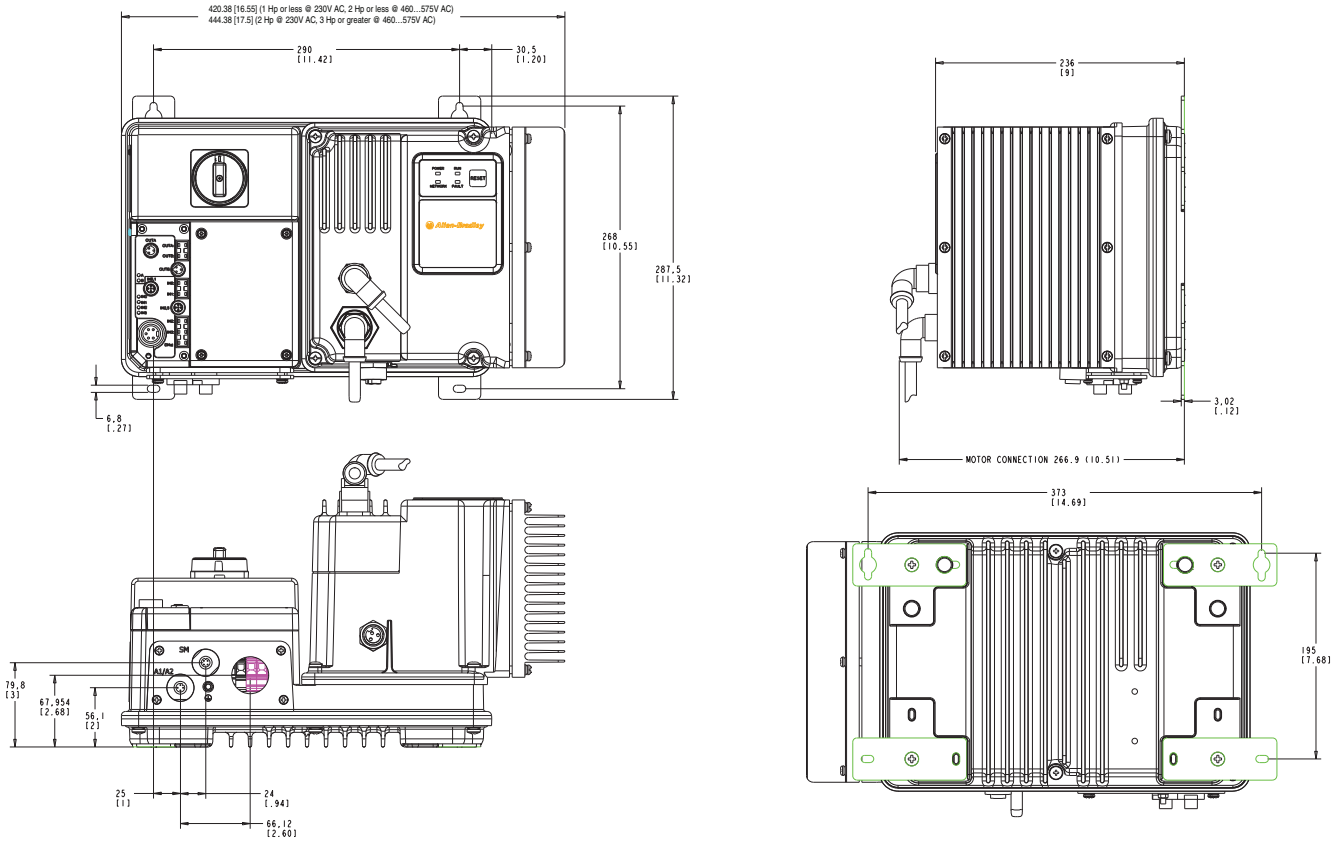
Sensorless Vector Control (SVC) Minimum DB Resistance

	Drive Rating		Minimum DB Resistance
Input Voltage	[kW]	[Hp]	[Ω]
480V, 50/60 Hz, Three-Phase	0.4	0.5	97
	0.75	1	97
	1.5	2	97
	2.2	3	97
	4.0	5	77

Approximate Dimensions

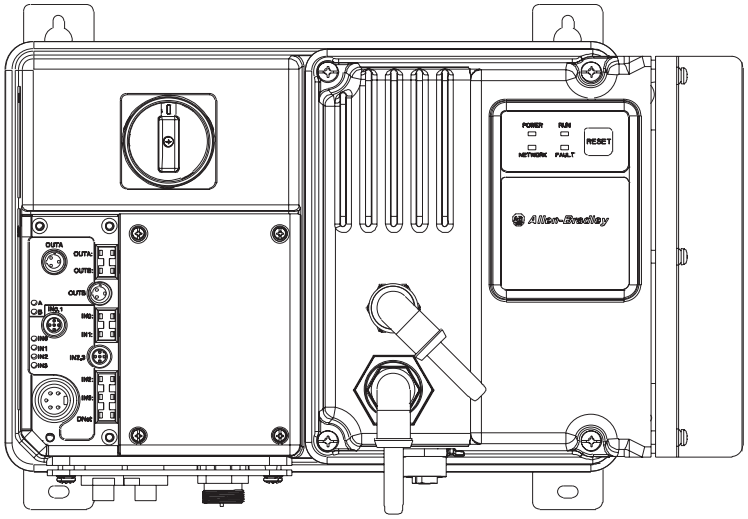
Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.

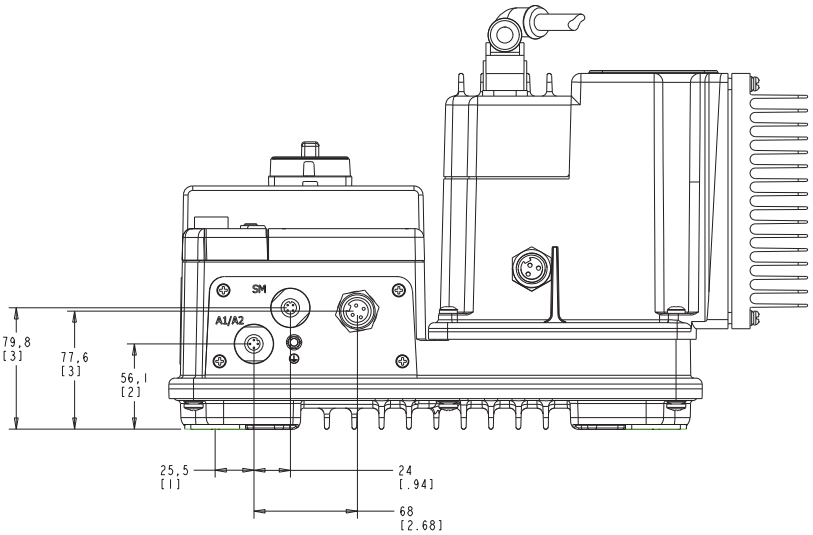
Dimensions for Safety Product with Conduit Entrance



Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.

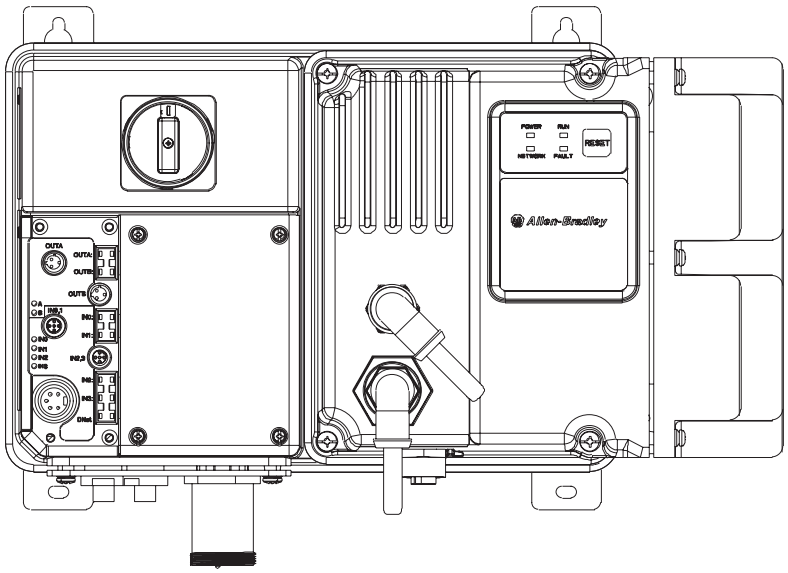
Dimensions for Safety Product, 2 Hp and below @ 460V AC, NEMA Type 4 with ArmorConnect™ Connectivity

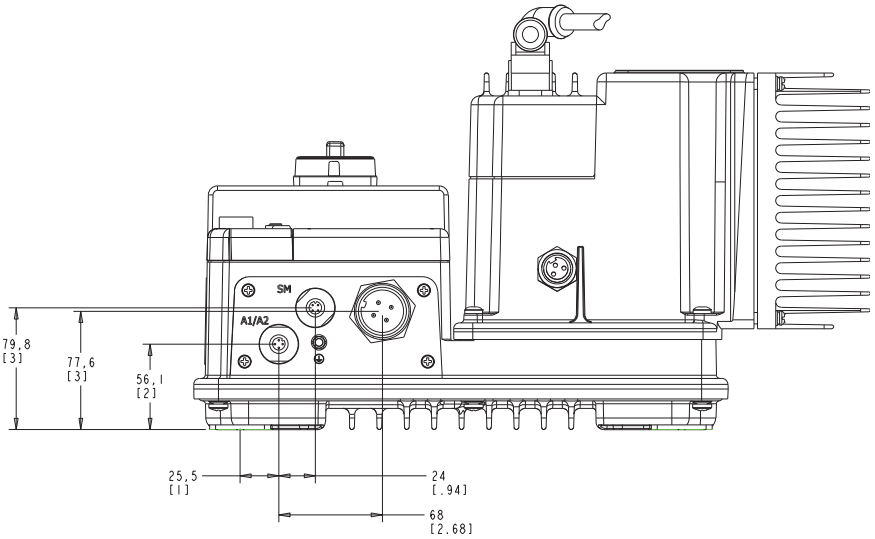




Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.

Dimensions for Safety Product, 3 Hp and above @ 460V AC, IP67/NEMA Type 4 with ArmorConnect Connectivity





DeviceNet Media ♣

Description		Length [m (ft)]	Cat. No.
			Sealed
	KwikLink pigtail drops are Insulation Displacement Connector (IDC) with integral Class 1 round cables for interfacing devices or power supplies to flat cable	1 (3.3)	**1485P-P1E4-B1-N5**
		2 (6.5)	**1485P-P1E4-B2-N5**
		3 (9.8)	**1485P-P1E4-B3-N5**
		6 (19.8)	**1485P-P1E4-B6-N5**
	DeviceNet Mini- T-Port Tap	Left Keyway	**1485P-P1N5-MN5KM**
		Right Keyway	1485P-P1N5-MN5NF

Description		Connector	Cat. No.
	Gray PVC Thin Cable	Mini Straight Female Mini Straight Male	1485G-P❄N5-M5
		Mini Straight Female Mini Right Angle Male	1485G-P❄W5-N5
		Mini Right Angle Female Mini Straight Male	1485G-P❄M5-Z5
		Mini Right Angle Female Mini Straight Male	1485G-P❄W5-Z5
	Thick Cable	Mini Straight Female Mini Straight Male	1485C-P‡N5-M5
		Mini Straight Female Mini Right Angle Male	1485C-P‡W5-N5
		Mini Right Angle Female Mini Straight Male	1485C-P‡M5-Z5
		Mini Right Angle Female Mini Straight Male	1485C-P‡W5-Z5

Description		Length m (ft)	Cat. No.
	DeviceNet Configuration Terminal Used to interface with objects on a DeviceNet network. Includes 1 m communications cable.	1 (3.3)	**193-DNCT**
	Communication cable, color-coded bare leads	1 (3.3)	193-CB1
	Communication cable, microconnector (male)	1 (3.3)	**193-CM1**
	Panel Mount Adapter/Door Mount Bezel Kit	—	**193-DNCT-BZ1**

♣ See On-Machine Connectivity Catalog for complete cable selection information.
❄ Replace symbol with desired length in meters (Example: **1485G-P1N5-M5** for a 1 m cable). Standard cable lengths: 1, 2, 3, 4, 5, and 6 m.
‡ Replace symbol with desired length in meters (Example: **1485C-P1N5-M5** for a 1 m cable). Standard cable lengths: 1, 2, 3, 4, 5, 6, 8, 10, 12, 18, 24, and 30 m.

Industrial EtherNet Media♣

Description	Connector Type	Unshielded Cat. No.
M12, D-Code Patchcords and Cordsets		
	Straight male to straight male	1585D-M4TBDM-∗
	Straight male to right angle male	1585D-M4TBDE-∗
	Right angle male to right angle male	1585D-E4TBDE-∗
	Straight male to straight female	1585D-M4TBDF-∗
Front Mount Receptacle		
	Front mount female to RJ45	1585D-D4TBJM-∗
Transition Cable		
	Straight male to RJ45	1585D-M4TBJM-∗

Description	Conductors	Jacket Material	Cable Type	Jacket Color	Cat. No.
RJ45 Patchcords					
	4-pair	Riser PVC	Unshielded twisted pair	Teal	1585J-M8PBJM-∗
		High-flex TPE		Teal	1585J-M8TBJM-∗
M12 to RJ45 Bulkhead Adapter					
	• Transition from IP20 environment to IP67 environment • In-cabinet connectivity with RJ45 connector providing On-Machine solution with M12 D Code connector • Differential 100 Ω terminators used for unused pairs • Cat 5e				**1585A-DD4JD**

∗ Lengths available in 0.3, 0.6, 1, 2, 5, 10, 15, and additional increments of 5 m, up to 75 m.
♣ See On-Machine Connectivity Catalog for complete cable selection information.

ArmorPoint® Media §

Description	Length [m (ft)]	Cat. No.
ArmorPoint Bus Extension Cable including Terminating Resistor	1 (3.3)	280A-EXT1
Extension Cable to connect two ArmorStart Distributed Motor Controllers to ArmorPoint communication protocol	1 (3.3)	280A-EXTCABLE

§ ArmorPoint media is only available with an IP67/NEMA Type 4 rating.

Sensor Media ⌘

DeviceNet/ArmorPoint Communications

Description		ArmorStart I/O Connection	Pin Count	Connector	Cat. No.
	DC Micro Patchcord	Input	4-pin	Straight Female Straight Male	889D-F4ACDM-➢
				Straight Female Right Angle Male	889D-F4ACDE-➢
	DC Micro V-Cable	Input	4-pin	Straight Female	879D-F4ACDM-➢
				Right Angle Female	879D-R4ACM-➢
	AC Micro Patchcord	Output	3-pin	Straight Female Straight Male	889R-F3AERM-➢
				Straight Female Right Angle Male	889R-F3AERE-➢

EtherNet/IP Communications

Description		ArmorStart I/O Connection	Pin Count	Connector	Cat. No.
	DC Micro Patchcord	Input/Output	4-pin	Straight Female Straight Male	889D-F4ACDM-➢
				Straight Female Right Angle Male	889D-F4ACDE-➢
	DC Micro V-Cable	Input	4-pin	Straight Female	879D-F4ACDM-➢
				Right Angle Male	879D-R4ACM-➢

⌘ See On-Machine Connectivity Catalog for complete cable selection information.
➢ Replace symbol with desired length in meters (Example: 889D-F4ACDM-1 for a 1 m cable). Standard cable lengths: 1, 2, 5, and 10 m.

4

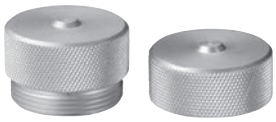
Motor and Brake Cables

Description		Cable Rating	Length [m (ft)]	Cat. No.
Motor Cable Cordsets	90° M22 Motor Cordset	IP67/NEMA Type 4	3 (9.8)	**280-MTR22-M3**
			6 (19.6)	**280-MTR22-M6**
			10 (32.8)	280-MTR22-M10
			14 (45.9)	**280-MTR22-M14**
			20 (65.6)	280-MTR22-M20
	90° M35 Motor Cordset	IP67/NEMA Type 4	3 (9.8)	280-MTR35-M3
			6 (19.6)	280-MTR35-M6
			10 (32.8)	**280-MTR35-M10**
			14 (45.9)	280-MTR35-M14
			20 (65.6)	280-MTR35-M20
	90° M22 Motor Cordset	IP69K/NEMA 4X	3 (9.8)	280S-MTR22-M3
			6 (19.6)	280S-MTR22-M6
			14 (45.9)	280S-MTR22-M14
	90° M35 Motor Cordset	IP69K/NEMA 4X	6 (19.6)	280S-MTR35-M6
			14 (45.9)	280S-MTR35-M14
Motor Cable Cordsets, High Flex∗	90° M22 Motor Cordset	IP67/NEMA Type 4	3 (9.8)	280-MTRF22-M3
			6 (19.6)	280-MTRF22-M6
			8 (26.2)	280-MTRF22-M8
			10 (32.8)	280-MTRF22-M10
			14 (45.9)	280-MTRF22-M14
			20 (65.6)	280-MTRF22-M20
Motor Cable Cordsets, Shielded (VFD)	90° M22 Motor Cordset	IP67/NEMA Type 4	3 (9.8)	284-MTRS22-M3
			6 (19.6)	**284-MTRS22-M6**
			14 (45.9)	284-MTRS22-M14
	90° M22 Motor Cordset	IP69K/NEMA Type 4X	3 (9.8)	284S-MTRS22-M3
			6 (19.6)	284S-MTRS22-M6
			14 (45.9)	284S-MTRS22-M14
Extended Source/Control Brake Cable Cordsets	90° M25 Source Brake Cable	IP67/NEMA Type 4	6 (19.6)	285-BRC25-M6
			14 (45.9)	285-BRC25-M14
		IP69K	6 (19.6)	285S-BRC25-M6
			14 (45.9)	285S-BRC25-M14
Extended Source/Control Brake Cable Cordsets, High Flex∗	90° M25 Source Brake Cable	IP67/NEMA Type 4	3 (9.8)	285-BRCF25-M3
			6 (19.6)	285-BRCF25-M6
			10 (32.8)	285-BRCF25-M10
			14 (45.9)	285-BRCF25-M14
			20 (65.6)	285-BRCF25-M20
Dynamic Brake Cables	M22 Dynamic Brake Cable (DB Option)	IP67/NEMA Type 4	3 (9.8)	285-DBK22-M3
		IP69K	3 (9.8)	285S-DBK22-M3

Description	Description	Cable Rating	Length [m (ft)]	Cat. No.
Motor Cable Patchcords	90° Male/Straight Female M22	IP67/NEMA Type 4	1 (3.3)	280-MTR22-M1D
			3 (9.8)	280-MTR22-M3D
	90° Male/Straight Female M35	IP67/NEMA Type 4	1 (3.3)	280-MTR35-M1D
			3 (9.8)	280-MTR35-M3D
	90° Male/Straight Female M22	IP69K/NEMA Type 4X	1 (3.3)	280S-MTR22-M1D
			3 (9.8)	280S-MTR22-M3D
	90° Male/Straight Female M35	IP69K/NEMA Type 4X	1 (3.3)	280S-MTR35-M1D
			3 (9.8)	280S-MTR35-M3D
Motor Cable Patchcords, Shielded (VFD)	90° Male/Straight Female M22	IP67/NEMA Type 4	1 (3.3)	284-MTRS22-M1D
			3 (9.8)	284-MTRS22-M3D
	90° Male/Straight Female M22	IP69K/NEMA Type 4X	1 (3.3)	284S-MTRS22-M1D
			3 (9.8)	284S-MTRS22-M3D

∗ 14 million flex cycles, bend radius is maximum 8X the cable diameter (0.362 in. OD).

Sealing Caps

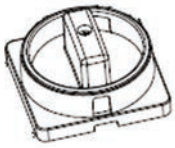


	ArmorPoint		DeviceNet		EtherNet/IP	
	Input	Output	Input	Output	Input	Output
	Cat. No.	Cat. No.	Cat. No.	Cat. No.	Cat. No.	Cat. No.
Plastic Sealing Cap (M12)∗	—	**1485A-M12**	**1485A-M12**	**1485A-M12**	**1485A-M12**	**1485A-M12**
AC Micro Aluminum Sealing Cap∗	—	**889A-RMCAP**	—	**889A-RMCAP**	—	—
Stainless Steel Sealing Cap‡	—	889AS-RMCAP	1485AS-C3	889AS-RMCAP	—	—
Motor Connector Aluminum Sealing Cap (M22) for 10 A protection∗	—	**1485A-C1**	—	**1485A-C1**	—	**1485A-C1**
Motor Connector Aluminum Sealing Cap (M35) for 25 A protection∗	—	**889A-QMCAP**	—	**889A-QMCAP**	—	**889A-QMCAP**
Dynamic Brake Connector (M22)	—	**1485A-C1**	—	**1485A-C1**	—	**1485A-C1**
Source/Control Brake Cap (M25)	—	♣	—	♣	—	♣

∗ To achieve IP67 rating, sealing caps must be installed on all unused I/O connections.
‡ To achieve IP69K/NEMA 4X rating, sealing caps must be installed on all unused I/O connections.
♣ Contact your local Rockwell Automation sales office or Allen-Bradley distributor.

4

Handle and Cord Accessories

	Description	Cat. No.
	Locking Tag • Padlock attachment to the lockable handles • Up to three padlocks 4…8 mm (5/16 in.) Ø shackle	**140M-C-M3**
	Replacement At-Motor Disconnect Handle Kit includes: (1) handle, (1) guard, and (3) screws	280-DISHDL
Cord grips for ArmorStart devices with 10 A short circuit protection rating		
	3/4 in. Strain relief cord connector and 3/4 in. lock nut Cable range: 0.31…0.56 in. Used with control power media cordset - Example cat. no.: 889N-M65GF-M2	Thomas & Betts Cord Grip Cat. No. 2931NM
	1 in. Strain relief cord connector and 1 in. lock nut Cable range: 0.31…0.56 in. Used with control power media cordset - Example cat. no.: 280-PWR22G-M	Thomas & Betts Cord Grip Cat. No. 2940NM
Cord grips for ArmorStart devices with 25 A short circuit protection rating		
	3/4 in. Strain relief cord connector and 3/4 in. lock nut Cable range: 0.31…0.56 in. Used with control power media cordset - Example cat. no.: 889N-M65GF-M2	Thomas & Betts Cord Grip Cat. No. 2931NM
	1 in. Strain relief cord connector and 1 in. lock nut Cable range: 0.70…0.95 in. Used with three-phase power media cordset - Example cat. no.: 280-PWR35G-M1	Thomas & Betts Cord Grip Cat. No. 2942NM

Dynamic Brake Selection for DB Option

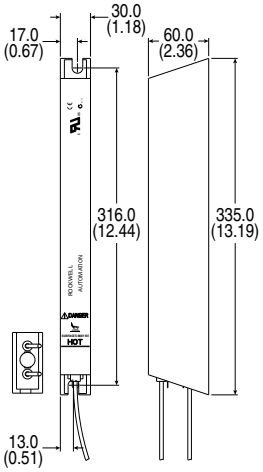
Drive and Motor Size [kW (Hp)]	Resistance [Ω]	Continuous Power [kW]	Max. Energy [kJ]	Max. Braking Torque [% of motor]	Application Type 1❄ Braking Torque [% of motor]	Application Type 1❄ Duty Cycle‡	Application Type 2❄ Braking Torque [% of motor]	Application Type 2❄ Duty Cycle‡	Cat. No.∗
200…240V AC Input Drives									
0.37 (0.5)	91	0.086	17	293%	100%	48%	150%	31%	**AK-R2-091P500**
0.75 (1)				218%		23%	150%	15%	**AK-R2-091P500**
1.5 (2)				109%		11%	109%	11%	**AK-R2-091P500**
400…480V AC Input Drives									
0.37 (0.5)	360	0.086	17	305%	100%	47%	150%	31%	**AK-R2-360P500**
0.75 (1)	360	0.086	17	220%		23%	150%	15%	**AK-R2-360P500**
1.5 (2)	360	0.086	17	110%		12%	110%	11%	**AK-R2-360P500**
2.2 (4)	120	0.26	52	197%		24%	150%	16%	**AK-R2-120P1K2**
4 (5)	120	0.26	52	124%		13%	124%	10%	**AK-R2-120P1K2**
600V AC Input Drives									
0.37 (0.5)	360	0.086	17	274%	100%	46%	150%	31%	**AK-R2-360P500**
0.75 (1)	360	0.086	17	251%		23%	150%	15%	**AK-R2-360P500**
1.5 (2)	360	0.086	17	172%		11%	150%	8%	**AK-R2-360P500**
2.2 (4)	120	0.26	52	193%		24%	150%	16%	**AK-R2-120P1K2**
4 (5)	120	0.26	52	186%		13%	150%	9%	**AK-R2-120P1K2**

∗ Check resistor ohms against the minimum resistance for the drive that is being used.
‡ The duty cycle listed is based on the full speed to zero deceleration. For constant regen at full speed, the duty cycle capability is half the values listed.
❄ Application Type 1 represents maximum capability up to 100% of braking torque, where possible. Application Type 2 represents greater than 100% of braking torque up to a maximum of 150%, where possible.

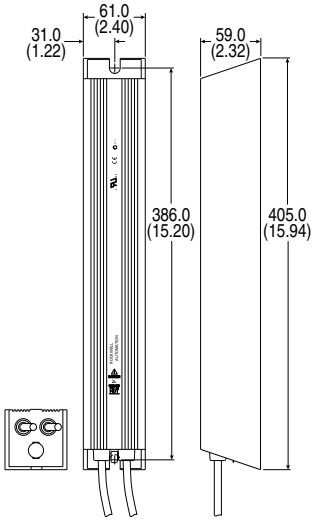
ArmorStart Bulletin 284 Option DB (IP20) Resistor Installation Dimensions

Dimensions are in millimeters (inches) and weights are in kilograms (pounds). Dimensions are not intended to be used for manufacturing purposes.

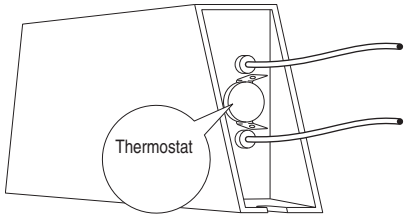
Frame A



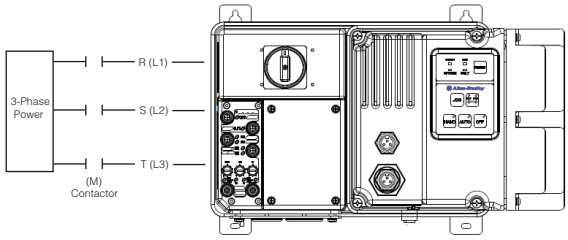
Frame B

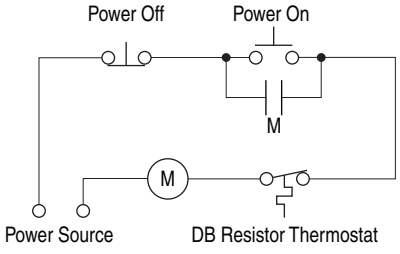


Frame	Cat. No.	Weight [kg (lb)]
A	AK-R2-091P500, AK-R2-047P500, AK-R2-360P500	1.1 (2.5)
B	AK-R2-030P1K2, AK-R2-120P1K2	2.7 (6)



Recommended thermostat control wiring to prevent dynamic brake overheating





Dynamic Brake Selection for DB1 (IP67) Option

Drive and Motor Size [kW (Hp)]	Resistance [Ω]	Continuous Power [kW]	Max. Energy [kJ]	Max. Braking Torque [% of motor]	Application Type 1❄ Braking Torque [% of motor]	Application Type 1❄ Duty Cycle‡	Application Type 2❄ Braking Torque [% of motor]	Application Type 2❄ Duty Cycle‡	Cat. No.§
200…240V AC Input Drives									
0.37 (0.5)	91	0.086	17	293%	100%	46%	150%	31%	284R-091P500-M∗
0.75 (1)				218%		23%	150%	15%	284R-091P500-M∗
1.5 (2)				109%		11%	109%	11%	284R-091P500-M∗
400…480V AC Input Drives									
0.37 (0.5)	360	0.086	17	305%	100%	47%	150%	31%	284R-360P500-M∗
0.75 (1)	360	0.086	17	220%		23%	150%	15%	284R-360P500-M∗
1.5 (2)	360	0.086	17	110%		12%	110%	11%	284R-360P500-M∗
2.2 (4)	120	0.26	52	197%		24%	150%	16%	284R-120P1K2-M∗
4 (5)	120	0.26	52	124%		13%	124%	10%	284R-120P1K2-M∗
600V AC Input Drives									
0.37 (0.5)	360	0.086	17	274%	100%	46%	150%	31%	284R-360P500-M∗
0.75 (1)	360	0.086	17	251%		23%	150%	15%	284R-360P500-M∗
1.5 (2)	360	0.086	17	172%		11%	150%	8%	284R-360P500-M∗
2.2 (4)	120	0.26	52	193%		24%	150%	16%	284R-120P1K2-M∗
4 (5)	120	0.26	52	185%		13%	150%	9%	284R-120P1K2-M∗

∗ Length is user-selectable based on a suffix added to the catalog number. For a length of 500±10 mm, add **-M05** to the end of the catalog number. For a length of 1000±10 mm, add **-M1** to the end of the catalog number.

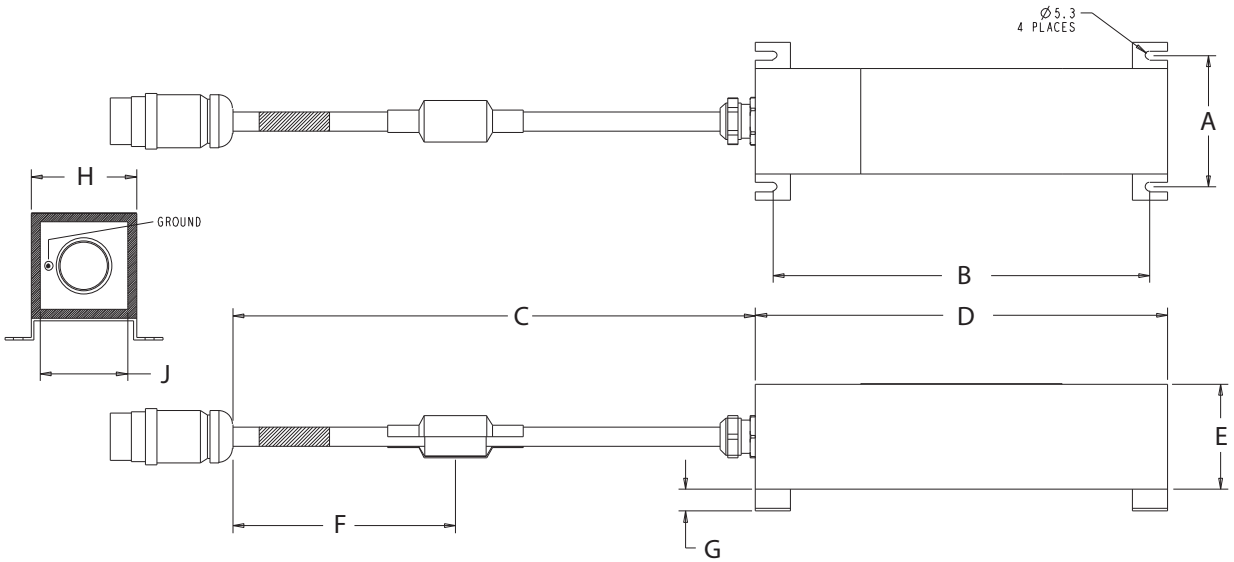
‡ The duty cycle listed is based on the full speed to zero deceleration. For constant regen at full speed, the duty cycle capability is half the values listed.

❄ Application Type 1 represents maximum capability up to 100% of braking torque, where possible. Application Type 2 represents greater than 100% of braking torque up to a maximum of 150%, where possible.

§ Drive rating and DB part numbers are not interchangeable. Only use specified resistor. Customer is responsible to evaluate if performance meets application requirement

ArmorStart Bulletin 284 Option DB1 (IP67) Resistor Installation Dimensions

Dimensions are in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.



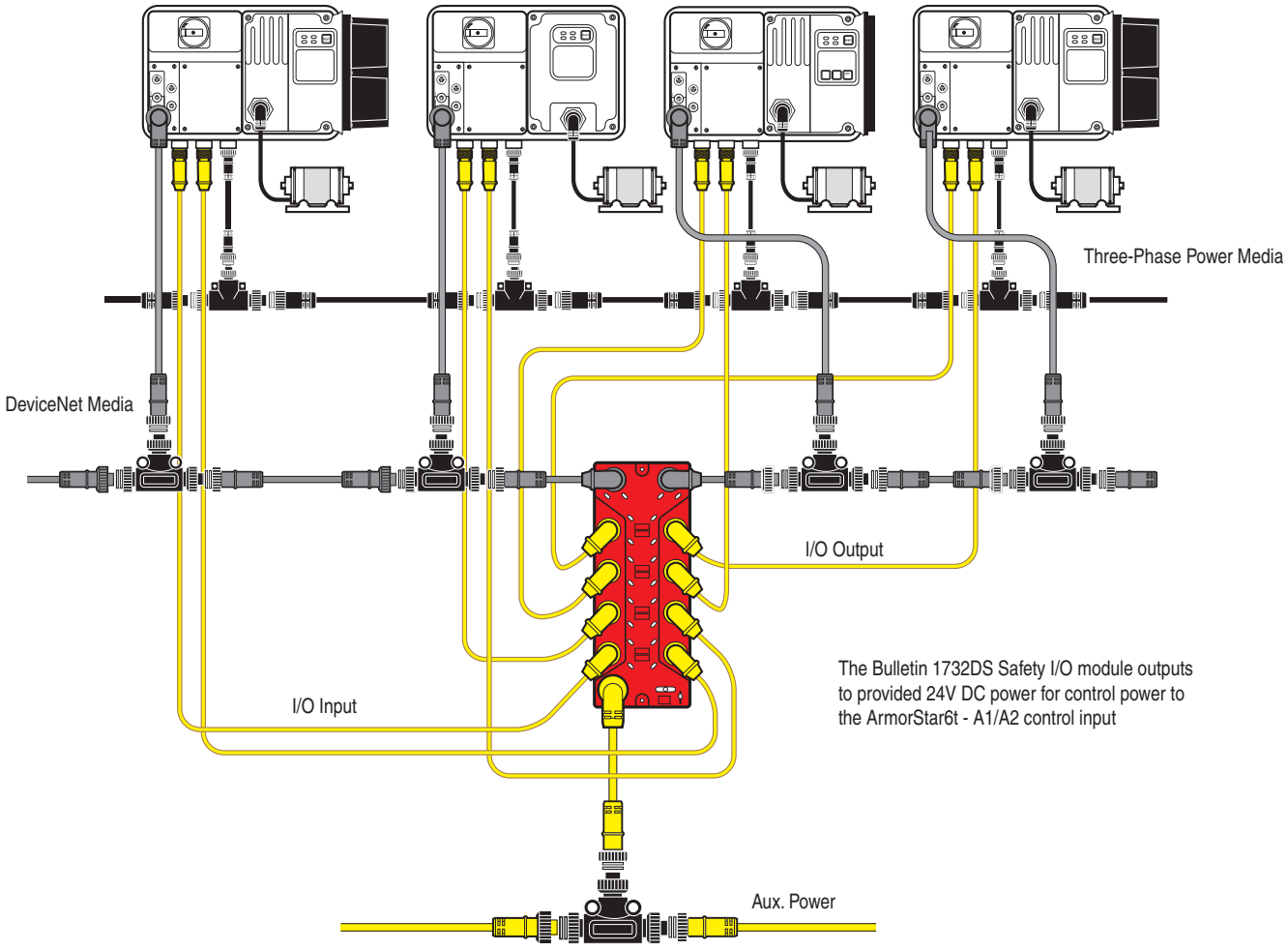
Cat. No.	A	B	C	D	E	F	G	H	J
284R-091P500	89 ±3 (3.5 ±0.12)	215 ±5 (8.46 ±0.2)	M05 = 0.5 meter M1 = 1 meter	235 ±5 (9.25 ±0.2)	60 ±2 (2.36 ±0.08)	127 (5)	12.54 (0.49)	60 ±2 (2.36 ±0.08)	50 ±1.5 (1.97 ±0.06)
284R-360P500		215 ±5 (8.46 ±0.2)		235 ±5 (9.25 ±0.2)					
284R-120P1K2		420 ±5 (16.54 ±0.2)		440 ±5 (17.32 ±0.2)					

Safety I/O Module and TÜV Requirements

ArmorStart Safety-Related Parts

Each ArmorStart Safety Distributed motor controller is intended to be combined with the Cat. No. 1732DS-IB8XOBV4 safety I/O module to form a subsystem that is part of the overall machine stop function. The motor controllers are connected to the safety I/O module through specified cable assemblies. The combination of one of these controllers, the safety module, and the specified interconnecting cables are referred to as the ArmorStart Safety-Related Parts. The catalog numbers for each of these components is specified below. The combination of these components is shown below. The safety I/O module and PLC program must be configured appropriately to meet TÜV CAT4 PLe certification. Refer to the user manual for details.

Catalog Number	Description
280…S* * - denotes safety version of Bulletin 280	Bulletin 280 Distributed Motor Controller – controller is full-voltage, non-reversing
281…S* * - denotes safety version of Bulletin 281	Bulletin 281 Distributed Motor Controller – controller is full-voltage, reversing
284…S* * - denotes safety version of Bulletin 284	Bulletin 284 Distributed Motor Controller – controller is variable-frequency AC drive
1732DS-IB8XOBV4	Guard I/O DeviceNet Safety Module
889D-F4AEDM-1* or equivalent For standard lengths, replace * symbol with 0M3 (1 ft), 1 (1 m), 2 (2 m), 5 (5 m) or 10 (10m).	For use with: SM Connector - Patch cable between Safety I/O module input and ArmorStart connector labeled “SM”. This provides status feedback to the safety system. A1/A2 connector - Patch cable assembly between Safety I/O module output and ArmorStart connector labeled “A1/A2”. This provides coil power to contactors and and ArmorStart power supply. See On-Machine Connectivity Catalog for complete cable selection information.

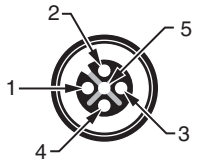

Three-Phase Power Media
DeviceNet Media
I/O Output
I/O Input
The Bulletin 1732DS Safety I/O module outputs to provided 24V DC power for control power to the ArmorStar6t - A1/A2 control input
Aux. Power

The Bulletin 1732DS Safety I/O module inputs will monitor the status of the safety-related contactors inside the ArmorStart - SM safety monitor input

ArmorBlock® Guard I/O™ Modules

Description		Cat. No. Modification
	ArmorBlock® Guard I/O™ provides all the advantages of traditional distributed I/O for safety systems, but has an IP67 package that can be mounted directly on your machine. You can use Guard Safety I/O with any safety controller that communicates on DeviceNet using CIP Safety for the control and monitoring of safety circuits. Guard I/O detects circuit failures at each I/O point while providing detailed diagnostics directly to the controller. For assistance and example configuration, see the Safety Accelerator for GuardLogix Systems at www.ab.com	**1732DS-IB8XOBV4**

1732DS ArmorBlock Guard I/O Micro Connector Pin Assignments♣

Input Configuration		Female	Output Configuration	
Pin	Signal		Pin	Signal
1	Test Output n+1		1	Output +24V DC Power
2	Safe Input n+1		2	Output n+1 (Sinking)
3	Input Common		3	Output Power Common
4	Safe Input n		4	Output n (Sourcing)
5	Test Output n		5	Output Power Common

♣ ArmorStart Safety version uses a 4-pin male connector, pin 5 is not used. Either a 4- or 5-pin patch cord can be used.

1732DS ArmorBlock Guard I/O Mini Connector Pin Assignments

ArmorBlock Guard I/O DeviceNet Configuration			
Pin	Signal	Male	Female
1	Drain		
2	V+ (Red)		
3	V- (Black)		
4	CAN_H (White)		
5	CAN_L (Blue)		

ArmorBlock Guard I/O Power Configuration		
Pin	Signal	Male
1	Output +24V dc Power (Red)	
2	Input +24V dc Power (Green)	
3	Input Power Common (White)	
4	Output Power Common (Black)	

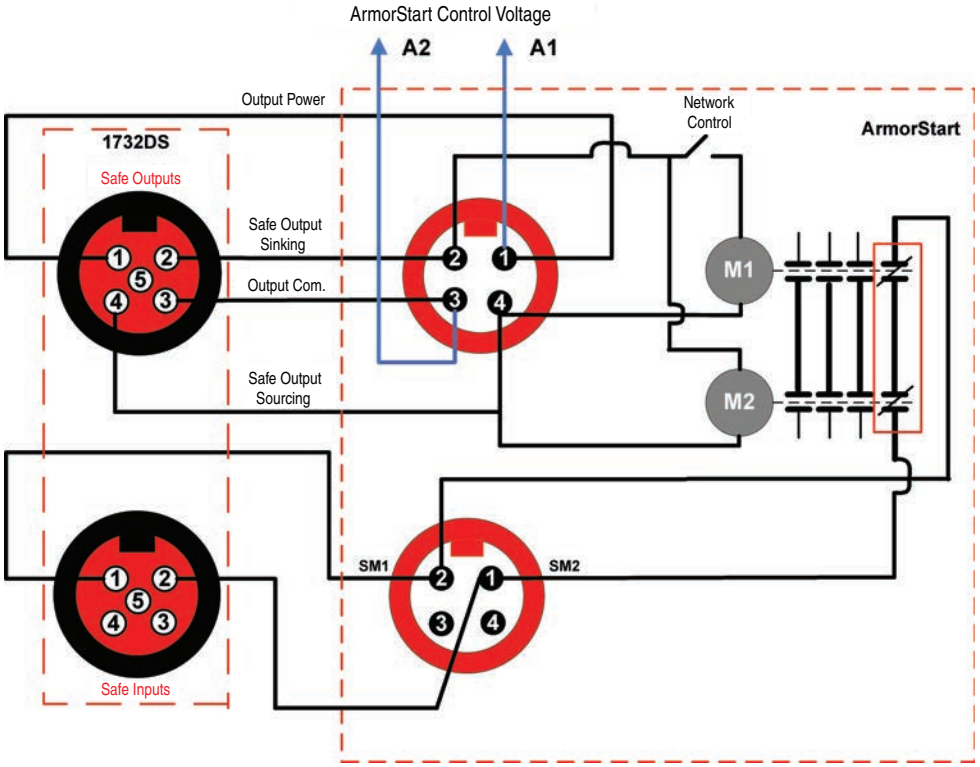
ArmorBlock Guard I/O Recommended Compatible Cables and Connectors*

	Description		Cat. No.
	DC Micro (M12) Male Cordset		889D-F4HJ-❄
	Five-pin M12 patchcord, 1 m (39.37 in.)	PVC jacket offers good oil and chemical resistance	889D-F4AEDM-*
		TPE jacket material for good oil, chemical, and weld slag resistance	889D-F4HJDM-‡
	M12 Terminal Chamber—Straight Male		871A-TS4-DM
	M12 Terminal Chamber—Right Angle Male		871A-TR4-DM

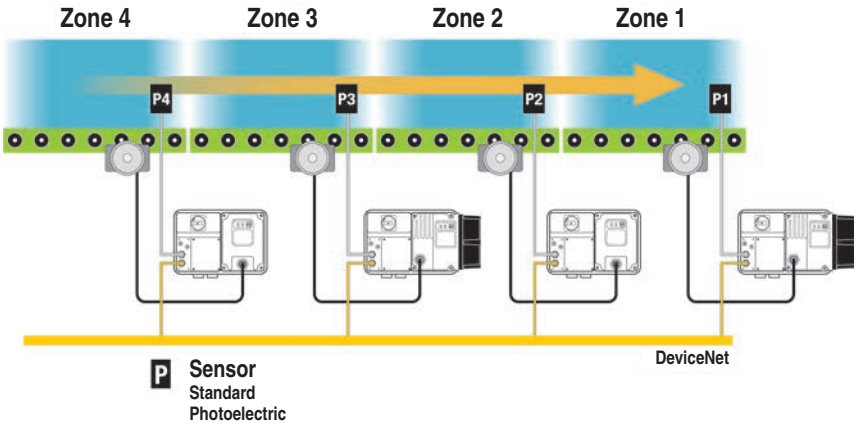
* All cables must use 5-pin connections for ArmorBlock Guard I/O M12 input compatibility.
❄ Replace symbol with 0M3 (0.3 m), 2 (2 m), or 5 (5 m) for standard cable length.
‡ Replace symbol with 1 (1 m), 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable length.

4

ArmorStart Safety Version and Guard I/O Module Connection Diagram



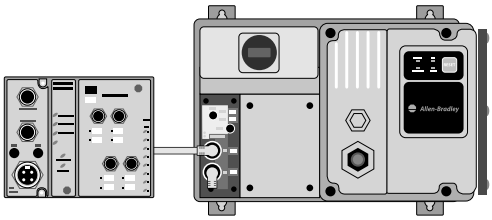
Peer-to-Peer Communications



(ZIP) Zone interlocking Parameters

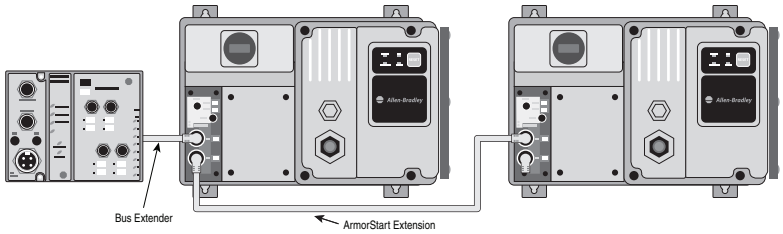
The Zone Control capabilities of ArmorStart Distributed Motor Controller is ideal for large horsepower (0.5…10 Hp) motored conveyors. The ArmorStart Distributed Motor Controllers have built-in DeviceNet Communications, DeviceLogix technology, and the added Zone Interlocking Parameters (ZIP), which allow one ArmorStart to consume data directly from up to four other DeviceNet nodes without going through the network scanner. These direct communications between conveyor zones are beneficial in a merge, diverter, and accumulation conveyor applications.

ArmorStart to ArmorPoint Connectivity - (Networks other than DeviceNet)



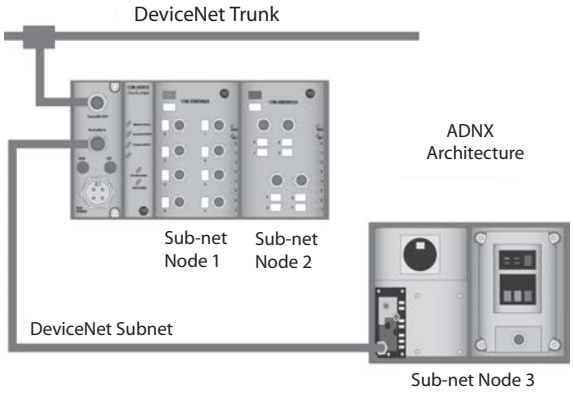
When connecting to the Bulletin 1738 ArmorPoint Distributed I/O product, a network adapter and at least one ArmorPoint Digital Output, Digital Input, Analog, AC and Relay product, or Specialty product must be selected. The ArmorPoint Distributed I/O can accomodate up to 63 modules per network node. The cable that connects the ArmorPoint Distributed I/O product to the ArmorStart Distributed Motor Controller is the Cat. No. 280A-EXT1. The Cat. No. 280A-EXT1 includes an ArmorPoint bus extension cable and a network terminating resistor.

Note: Access to DeviceLogix programming is available with RSNetworx for DeviceNet.



If an additional ArmorStart Distributed Motor Controller is to be connected, the Cat. No. 280A-EXTCABLE will be required. A maximum of two ArmorStart Distributed Motor Controllers can be connected to the Bulletin 1738 Distributed I/O.

I/O Expansion with DeviceNet



If the I/O capability of the Bulletin 280/281D ArmorStart Distributed Motor Controller needs to be expanded beyond the standard four inputs and two outputs, the ArmorStart Distributed Motor Controller with the DeviceNet communication protocol can be configured to the ADNX Architecture, in which the ArmorStart is part of the DeviceNet subnet, using the Cat. No. 1738-ADNX ArmorPoint Distributed I/O product.

Bulletin 1738 ArmorPoint Distributed I/O Products

Digital Output Products

Description	Cat. No.
24V DC, eight source output with eight M12 connectors	**1738-OB8EM12**
24V DC, eight source output with eight M8 connectors	**1738-OB8EM8**
24V DC, four source output with four M12 connectors	**1738-OB4EM12**
24V DC, four source output with four M8 connectors	1738-OB4EM8
24V DC, two source output with two M12 connectors	**1738-OB2EM12**
24V DC, two source output, 2 A prot. with two M12 connectors	**1738-OB2EPM12**
24V DC, four sink output with four M12 connectors	1738-OV4EM12

Digital Input Products

Description	Cat. No.
24V DC, eight sink input with four M12 connectors, two points per connector	**1738-IB8M12**
24V DC, eight sink input with eight M8 connectors	**1738-IB8M8**
24V DC, eight sink input with one M23 connector	**1738-IB8M23**
24V DC, four sink input with four M12 connectors	**1738-IB4M12**
24V DC, four sink input with four M8 connectors	**1738-IB4M8**
24V DC, two sink input with two M12 connectors	**1738-IB2M12**
24V DC, four source input with four M12 connectors	**1738-IV4M12**

Analog Products

Description	Cat. No.
24V DC analog current input with two M12 connectors	**1738-IE2CM12**
24V DC analog voltage input with two M12 connectors	**1738-IE2VM12**
24V DC analog current output with two M12 connectors	**1738-OE2CM12**
24V DC analog voltage output with two M12 connectors	**1738-OE2VM12**
24V DC, two thermocouple input	**1738-IT2IM12**
24V DC, two RTD input	**1738-IR2M12**

Power Supply Products

Description	Cat. No.
ArmorPoint I/O Field Potential Distributor Module	**1738-FPD**
24V DC Expansion Power Supply	**1738-EP24DC**

AC and Relay Products

Description	Cat. No.
24V DC Coil, N.O. DPST relay with two M12 connectors	**1738-OW4M12**
24V DC Coil, N.O. DPST relay with two AC M12 connectors	**1738-OW4M12AC**
120V AC, two input with two AC 4-pin M12 connectors	**1738-IA2M12AC4**
120V AC, two input with two AC 3-pin M12 connectors	1738-IA2M12AC3
120/230V AC, two output with two AC 3-pin M12 connectors	**1738-OA2M12AC3**

Specialty Products

Description	Cat. No.
ArmorPoint I/O RS-232 ASCII Serial Interface Module	**1738-232ASCM12**
ArmorPoint I/O RS-485 ASCII Serial Interface Module	**1738-485ASCM12**
24V DC Very High Speed Counter Module	**1738-VHSC24M23**
ArmorPoint 5V Encoder/Counter Module	**1738-IJM23**
ArmorPoint Synchronous Serial Interface Module with Absolute Encoder	**1738-SSIM23**

Adapter Products

Description	Cat. No.
ArmorPoint DeviceNet Adapter Module, Drop or Pass-through, with male and female M12 connectors	**1738-ADN12**
ArmorPoint DeviceNet Adapter Module, Drop only, with male M18 connector	**1738-ADN18**
ArmorPoint DeviceNet Adapter Module, Drop or Pass-through, with male and female M18 connectors	**1738-ADN18P**
ArmorPoint DeviceNet 24V DC Adapter Module with subnet expansion	**1738-ADNX**
ArmorPoint Redundant ControlNet Adapter Module	**1738-ACNR**
ArmorPoint Ethernet/IP 10/100 Mbps Adapter Module	**1738-AENT**
ArmorPoint I/O 2-Port EtherNet/IP Adapter (star, tree, linear, or ring topology)*	**1738-AENTR**

* Requires a 24V DC expansion power unit (cat. no. 1738-EP24DC) when two ArmorStarts are connected to point bus.

Three-Phase Power Media

	Three-Phase Power Trunk Cable	Three-Phase Power Drop Cable	Three-Phase Power Tees and Reducers	Three-Phase Power Receptacles	Three-Phase Power Accessories
Description	• Cordset - Cable with Integral Female or Male connector on one end • PatchCord - Cable with integral female or male connector on each end	• Cordset - Cable with Integral Female or Male connector on one end • PatchCord - Cable with integral female or male connector on each end	• Tee - Connects to a single drop line to trunk with M35 connectors • Reducing Tee - Connects to a single M22 drop line to trunk M35 connector • Reducer - Connects from M35 male connector to M22 female connector	• Female receptacles are a panel mount connector with flying leads • Male receptacles are a motor juction box mounted connector with flying leads	• Sealing Caps offered in versions to interface with female or male connectors • Locking Clips clamshell design clips over three power phase connector to limit customer access
Features	• Rated for Motor Branch Circuits - Meets UL 2237 for Industrial Machinery - 65ka High fault rating (SCCR) - Rated for wash down environments • Straight or Right Angle Connectors • 4-pin connector type • Cable Rating: TC-ER/• STOOW • Multiple Standard lengths	• Rated for Motor Branch Circuits - Meets UL 2237 for Industrial Machinery - 65ka High fault rating (SCCR) - Rated for wash down environments • Straight or Right Angle Connectors • 4-pin connector type • Cable Rating: TC-ER/STOOW • Multiple Standard lengths	• Rated for Motor Branch Circuits - Meets UL 2237 for Industrial Machinery - 65ka High fault rating (SCCR) - Rated for wash down environments • Trunk Tee, Reducing Tee and Reducer • 4-pin connector type	• Rated for Motor Branch Circuits - Meets UL 2237 for Industrial Machinery - 65ka High fault rating (SCCR) - Rated for wash down environments • Male and female configurations • 4-pin connector type • 1/2 in. NPT • Available in 1 meter length	• Sealing Caps - Available in M35 and M22 styles • Locking Clips - Designed for M35 and M22 connectors
Rated Voltage	600V	600V	600V	600V	—
Connector Body Dimensions	• Straight: 88.9 mm x 38.6 mm • Right Angle: 75.5 mm x 74 mm	• Straight: 56. mm x 25.4 mm • Right Angle: 44.9 mm x 40.4 mm	• Trunk Tee: 108 mm x 73.6 mm • Reducing Tee: 108 mm x 65.5 mm • Reducer: 112.5 mm x 38.1 mm	• M22 Female: 33.45 mm x 25.45 mm • M22 Male: 28.04 mm x 25.45 mm • M35 Female: 71.12 mm x 38.10 mm • M35 Male: 63.50 mm x 38.10 mm	—
Product Selection	**Page 4-97**	**Page 4-98**	**Page 4-99**	**Page 4-101**	**Page 4-107**

Control Power Media

	Control Power Cordsets & Patchcords	Control Power T-ports	Control Power Receptacles	Control Power Shorting Plugs	Control Power Accessories
Description	• Cable with integral connector on either one or both ends	• Cable with single male connector attached to two female connectors	• Panel mount connector with flying leads	• Integral connector with leads shorted for specific application requirements	• Sealing caps, mounting nuts, and sealing washers
Features	• 6-pin/5-used configuration • Male and female • Straight or right angle versions • 16 AWG conductors, cable dual rated UL TC/Open Wiring and STOOW • Multiple Standard lengths	• 6-pin/5-used configuration • Compact design • Color-coded E-stop in and E-stop out configurations	• 6-pin/5-used configuration • Male and female • 16 AWG conductors • 1/2 NPT mounting threads • Multiple standard lengths	• 6-pin/5-used configuration • Male • Multiple versions color coded for simple identification	• Rugged durable construction • Designed to mate with Control Power media
Rated Voltage	600V	600V	600V	600V	—
Connector Body Dimensions	• Straight: 56 x 25 mm (2.2 x 1 in.) • Right Angle: 40 x 45 mm (1.6 x 1.8 in.)	72 x 64 mm (2.8 x 2.5 in.)	30 x 25 mm (1.2 x 1 in.)	56 x 25 mm (2.2 x 1 in.)	—
Product Selection	**Page 4-103**	**Page 4-104**	**Page 4-105**	**Page 4-106**	**Page 4-107**

Description

The power media offers both three-phase and control power cable systems of cordsets, patchcords, receptacles, tees, reducers and accessories, to be used with the ArmorStart Distributed Motor Controller. These cable system components allow quick connection of ArmorStart Distributed Motor Controllers, thereby reducing installation time. They provide for repeatable, reliable connection of the three-phase and control power to the ArmorStart Distributed Motor Controller and motor, by providing a plug and play environment that also avoids system mis-wiring.

Compared to the traditional conduit installations, with power media you profit and benefit from:

- Reduce commissioning time
- Plug and play design eliminates wiring errors
- Increased system design flexibility
- No special tools required
- Reduced labor costs

Three-Phase Power Media

The three-phase power media offers quick disconnect cables that provide a secure connection to the ArmorStart Distributed Motor Controller. The connectors can be straight or right angled and are physically keyed to prevent wiring mishaps. The cabling options include:

- **Cordsets:** Cable with integral male or female connector at one end and flying leads at the other
- **Patchcords:** Cable with integral connector at each end (one male, one female)

Available in 0.5, 1, 1.5, 2, 2.5, 3, 4, 6, 8, 10, 12, or 14 m lengths.

The three-phase power tee, reducing tee, and reducer offers flexibility in system design.

The receptacles provide a termination point at the panel and motor junction box. The female receptacles can be used for a panel mount connection. The male receptacles can be used for a quick disconnect at the motor junction box.

Three-phase power media components are rated for motor branch circuits per UL 2237.

Control Power Media

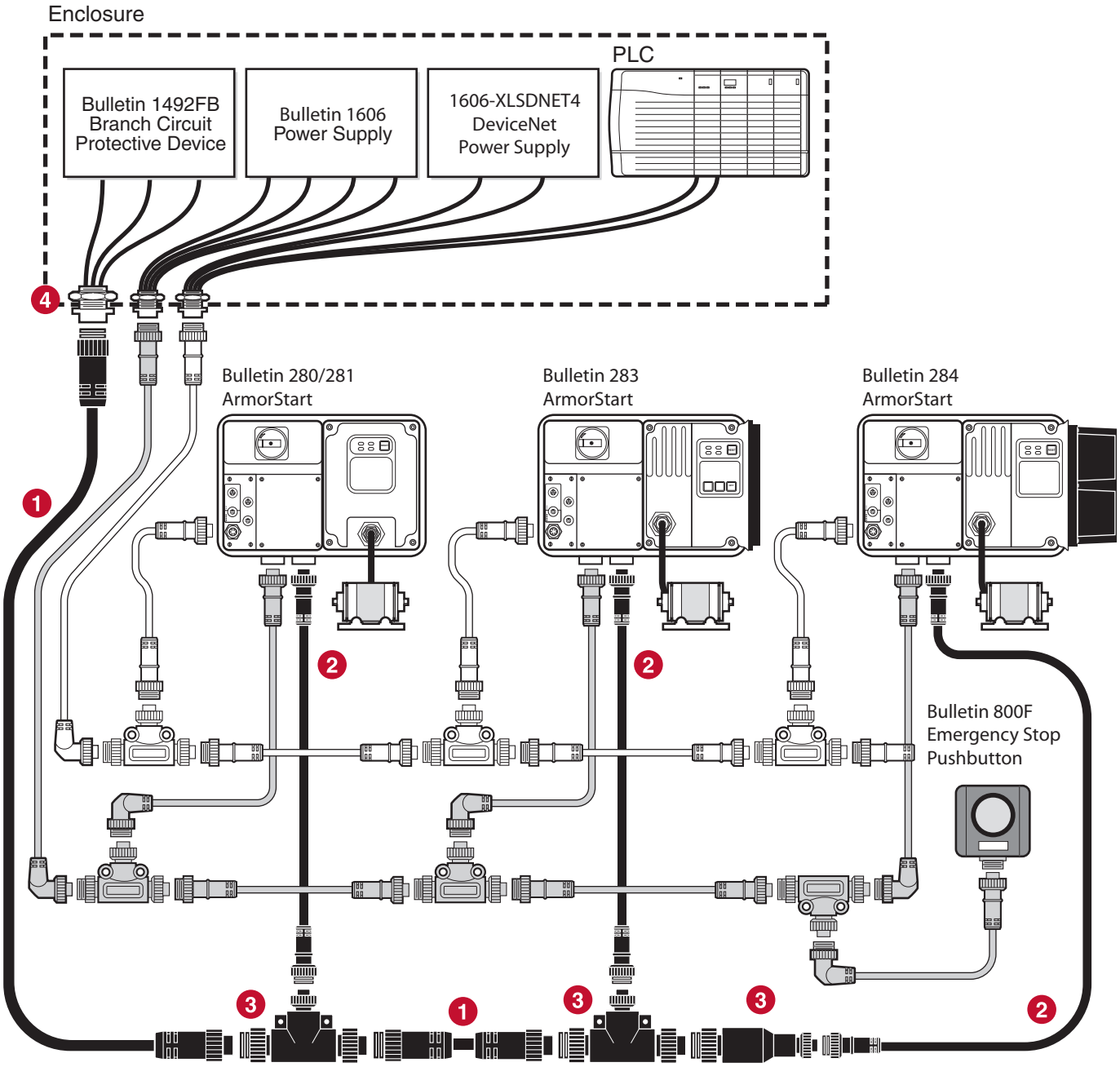
The control power media offers a mini disconnect cables that provides a secure connection to the ArmorStart Distributed Motor Controller. The control power media components are a 6-pin/5-used configuration to prevent mis-wiring with network connectors. The connectors can be straight or right angled and are physically keyed to prevent wiring mishaps. The cabling options include:

- **Cordsets:** Cable with integral male or female connector at one end and flying leads at the other
  Available in 2, 5, or 10 m lengths.
- **Patchcords:** Cable with integral connector at each end (one male, one female)
  Available in 1, 2, 3, 5, or 10 m lengths.

The control power tees offers flexibility in system design. The 6-pin/5-used T-port connects a single drop line to the trunk. Two types of tees are offered. The E-stop In tee is used to connect to the Bulletin 800F On-Machine E-Stop station using a control power media patchcord. The E-stop Out tee is used with cordset or patchcord to connect to the ArmorStart Distributed Motor Controller.

The receptacles provide a termination point at the panel and ArmorStart Distributed Motor Controller. The female receptacles can be used for a panel mount connection. The male receptacles can be used for a quick disconnect at the ArmorStart Distributed Motor Controller with gland plate design.

Three-Phase Power Media System Overview

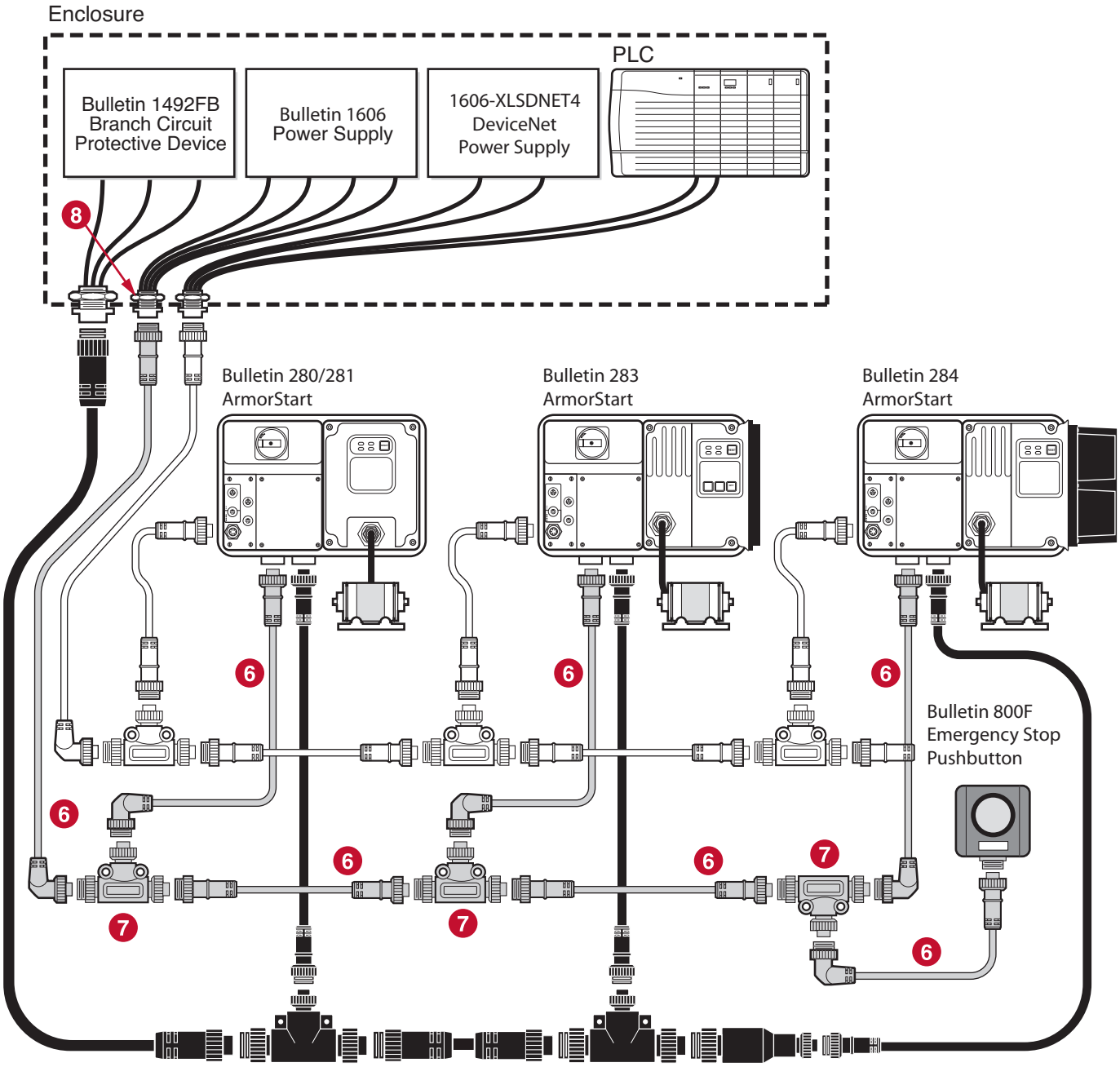


1. Three-Phase Power Trunk - Patchcord cable with integral female or male connector on each end (Example Cat. No.: 280-PWR35A-M*)
2. Three-Phase Drop Cable - PatchCord cable with integral female or male connector on each end (Example Cat. No.: 280-PWR22A-M*)
3. Three-Phase Power Tees and Reducer - Tee connects to a single drop line to trunk with quick change connectors (Cat. No.: 280-T35)
   Reducing Tee connects to a single drop line (Mini) to trunk (Quick change) connector (Cat. No.: 280-RT35)
   Reducer connects from quick change male connector to mini female connector(Cat. No.: 280-RA35)
4. Three-Phase Power Receptacles - Female receptacles are a panel mount connector with flying leads (Cat. No.: 280-M35F-M1)

Power Media

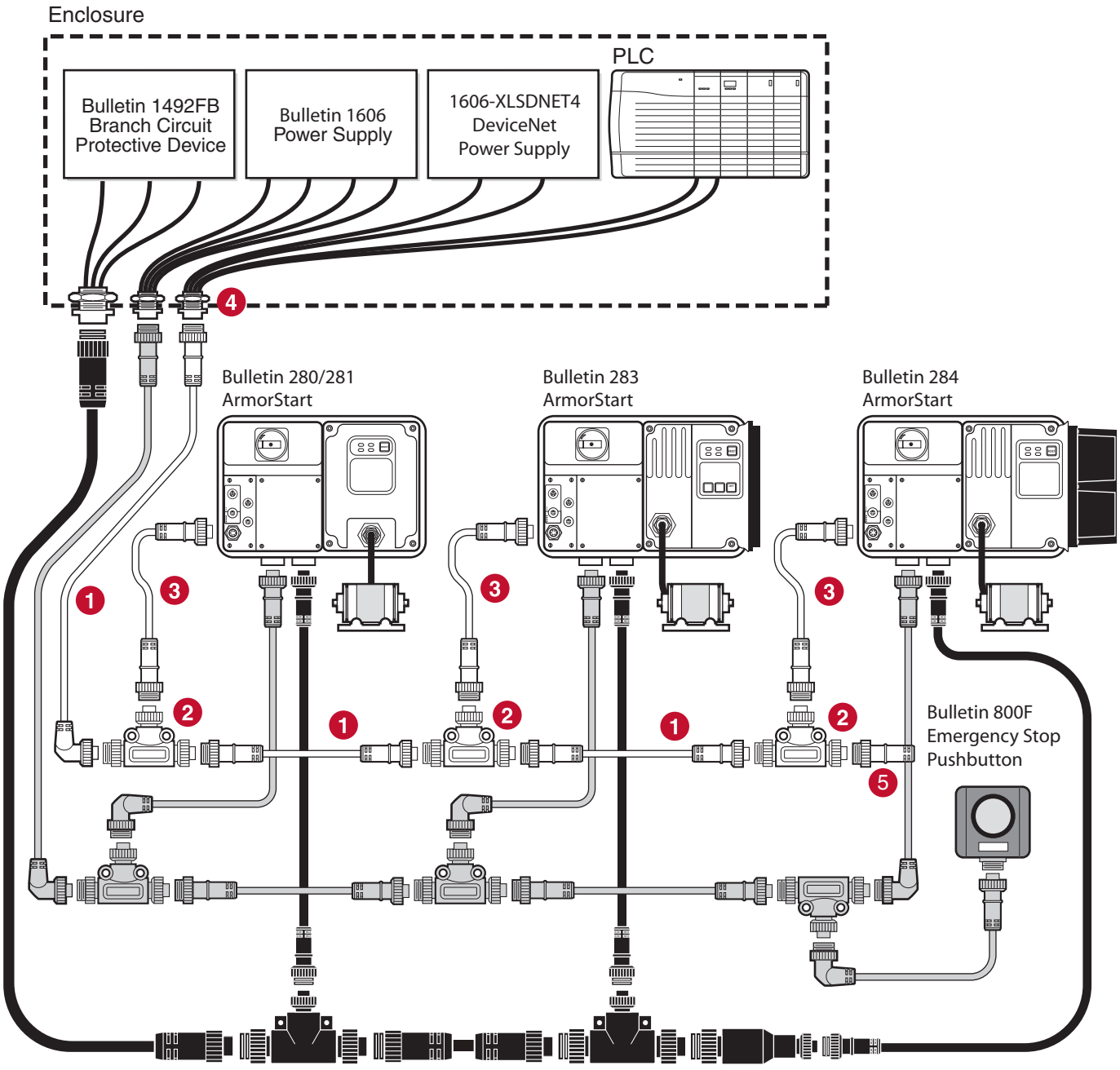
Control Power Media Diagram

Control Power Media System Overview



6. Control Power Media Patchcords - PatchCord cable with integral female or male connector on each end (Example Cat. No.: 889N-F65GFNM-*)
7. Control Power Tees - The E-stop In Tee (Cat. No.: 898N-653ST-NKF) is used to connect to the Bulletin 800F On-Machine E-Stop station using a control power media patchcord. The E-stop Out tee (Cat. No.: 898N-653ES-NKF) is used with cordset or patchcord to connect to the ArmorStart Distributed Motor Controller.
8. Control Power Receptacles - Female receptacles are a panel mount connector with flying leads (Cat. No.: 888N-D65AF1-*)

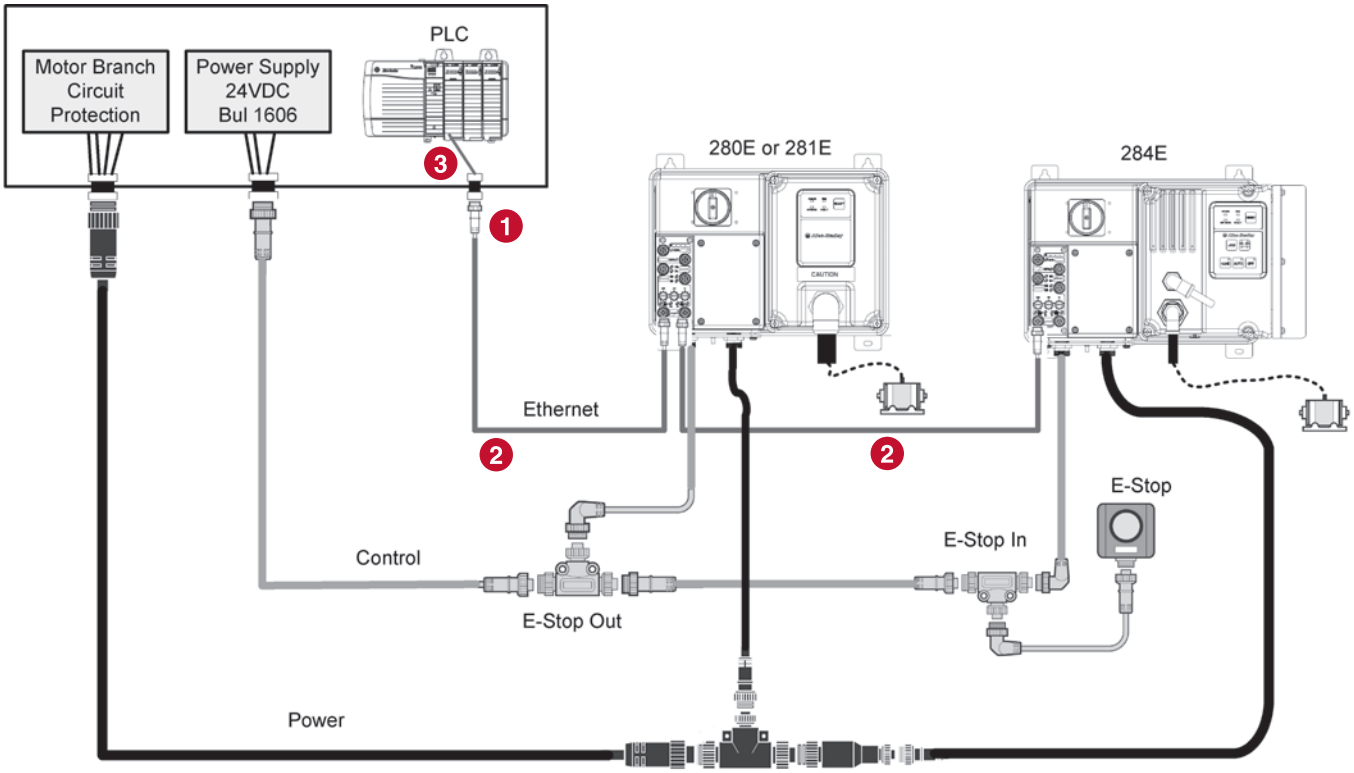
DeviceNet Media System Overview



1. DeviceNet Trunk Cable - Patchcord trunk cable with integral female or male connector on each end (example 1485C-P*N5-M5)
2. DeviceNet Mini- T-Port Tap - T-ports are used for connecting drops to the trunk line (example 1485P-P1N5-MN5KM)
3. DeviceNet Drop Cable - Drop cables and patch cords are used to connect devices to the network (example 1485G-P*M5-Z5)
4. DeviceNet Receptacle - Recepatcles are used when connections present but required (example 1485A–CXN5–M5)
5. DeviceNet Terminator - Properly designed DeviceNet networks require terminating resistors (example 1485A–T1N5)

Note: See the On-Machine Connectivity catalog for specific DeviceNet media components.

EtherNet Power Media System Overview



EtherNet Cat5e Connections:
1. CAT5e Bulkhead Connector and Receptacle (Example Cat. No.:1585A-DD4JD)
2. CAT5e Patch Cord, IP67, M12 D-Code, Male Straight, Male Right Angle (Example Cat. No.: 1585D-M4TBDE-*)
3. CAT5e, Patch Cable, IP20, RJ45 Male to RJ45 Male (Example Cat. No. 1585J-M4TB-*)

Note: See the On-Machine Connectivity catalog for specific EtherNet media components.

Bulletin 280 — Three-Phase Power Trunk Cables (Cordsets and Patchcords)

- Listed per UL 2237 for use in motor branch circuits per NFPA 79
- One piece molded design, M35 connection
- Can be used as a drop cable for 25 A rated ArmorStart Distributed Motor Controller or when desired to minimize voltage drops on extended cable runs

Table of Contents

Accessories..... 4-107

Standards Compliance

UL 2237

Certifications

UL Listed (File No. E318496, Guide PVVA)

Product Selection

Cordsets ❄

Pin Count	Assembly Rating	Cat. No.			
		Straight Female	Right-Angle Female	Straight Male	Right-Angle Male
4-pin	600V, 25 A	280-PWRM35E-M∗	280-PWRM35F-M∗	280-PWRM35G-M∗	280-PWRM35H-M∗

Patchcords ❄

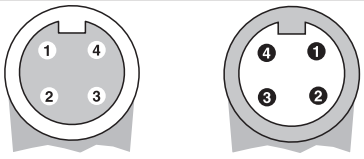
Pin Count	Assembly Rating	Cat. No.			
		Straight Female Straight Male	Right-Angle Female Straight Male	Straight Female Right-Angle Male	Right-Angle Female Right-Angle Male
4-pin	600V, 25 A	280-PWRM35A-M∗	280-PWRM35B-M∗	280-PWRM35C-M∗	280-PWRM35D-M∗

❄ Stainless steel version may be ordered by adding **S** to the cat. no. (Example: Cat. No. 280**S**-PWRM35A-M*)

∗ Replace symbol with code from table below that represents length desired.

Feet	1.62	3.3	4.9	6.5	8.1	9.8	13.1	19.7	26.2	32.8	39.4	45.9
Meters	0.5	1	1.5	2	2.5	3	4	6	8	10	12	14
Code	05	1	015	2	025	3	4	6	8	10	12	14

Pinout and Color Code

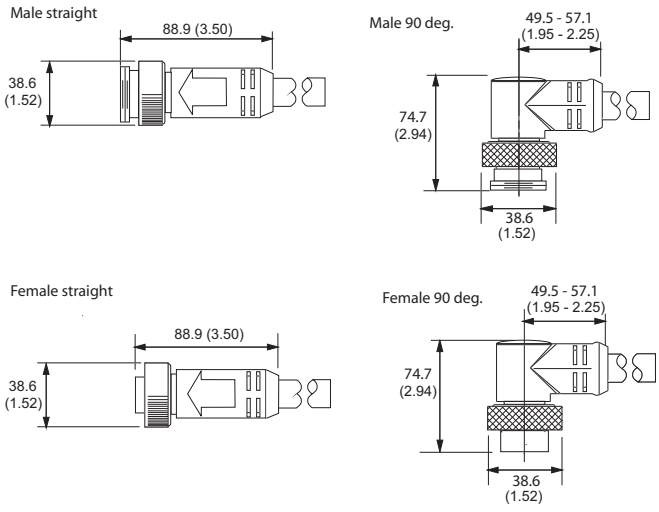
	Face View Pinout	
	4-Pin	
		
	Female	Male
Color Code	1 Black 2 Green/Yellow Extended PIN	3 Red 4 White

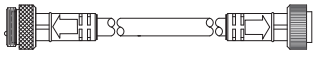
Specifications

Mechanical	
Coupling Nut	Black anodized aluminum
Housing	Black PVC
Insert	Black PVC
Cable Diameter	0.775 in. +/- 0.12 in. (19.68 mm +/- 0.5 mm) with four 10 AWG conductors
Electrical	
Contacts	Copper alloy with gold over nickel plating
Cable	Black PVC, dual rated UL TC/Open Wiring and STOOW
Cable Rating	600V AC/DC
Assembly Rating	4-pin — 10 AWG, 600V @ 25 A
Short Circuit Current Rating (SCCR)	**Circuit Breaker:** Suitable for use on a circuit capable of delivering not more than 65000 RMS symmetrical amperes at 480V AC maximum when protected by Bul. 140U-H frame circuit breaker, not rated more than 480V, 100 A and a maximum interrupting of 65000 RMS symmetrical amperes. **Fusing:** Suitable for use on a circuit capable of delivering not more than 65000 RMS symmetrical amperes at 600V AC maximum when protected by CC, J, and T class fuses.
Environmental	
Enclosure Type Rating	IP67, NEMA 4 & 6P; 1200 psi washdown
Operating Temperature	UL Type TC 600V 90 °C Dry 75 °C Wet, Exposed Run (ER) or MTW 600V 90 °C or STOOW 105 °C 600V - CSA STOOW 600V FT2

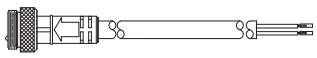
Approximate Dimensions

Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes and are subject to change.





Example of Patchcord



Example of Cordset

Three-Phase Power Media

Product Selection/Specifications/Approximate Dimensions

Bulletin 280 — Three-Phase Power Drop Cables (Cordsets and Patchcords)

- Listed per UL 2237 for use in motor branch circuits per NFPA 79
- One-piece molded design, M22 connection
- Can be used as a trunk cable for 10 A rated ArmorStart Distributed Motor Controller
- Can be used as a 10 or 15 A non-shielded motor cable

Table of Contents

Accessories..... 4-107

Standards Compliance

UL 2237

Certifications

UL Listed (File No. E318496, Guide PVVA)

Product Selection

Cordsets ❄

Pin Count	Assembly Rating	Cat. No.			
		Straight Female	Right-Angle Female	Straight Male	Right-Angle Male
4-pin	16 AWG, 600V, 10 A	280-PWRM22E-M∗	280-PWRM22F-M∗	280-PWRM22G-M∗	280-PWRM22H-M∗
4-pin	14 AWG, 600V, 15 A	280-PWRM24E-M∗	280-PWRM24F-M∗	280-PWRM24G-M∗	280-PWRM24H-M∗

Patchcords ❄

Pin Count	Assembly Rating	Cat. No.			
		Straight Female Straight Male	Right-Angle Female Straight Male	Straight Female Right-Angle Male	Right-Angle Female Right-Angle Male
4-pin	16 AWG, 600V, 10 A	280-PWRM22A-M∗	280-PWRM22B-M∗	280-PWRM22C-M∗	280-PWRM22D-M∗
4-pin	14 AWG, 600V, 15 A	280-PWRM24A-M∗	280-PWRM24B-M∗	280-PWRM24C-M∗	280-PWRM24D-M∗

❄ Stainless steel version may be ordered by adding **S** to the cat. no. (Example: Cat. No. 280**S**-PWRM22A-M*)

∗ Replace symbol with code from table below that represents length desired.

Feet	1.62	3.3	4.9	6.5	8.1	9.8	13.1	19.7	26.2	32.8	39.4	45.9
Meters	0.5	1	1.5	2	2.5	3	4	6	8	10	12	14
Code	05	1	015	2	025	3	4	6	8	10	12	14

Pinout and Color Code

	Face View Pinout	
	4-Pin	
	Female	Male
Color Code	1 Black 2 White	3 Red 4 Green/Yellow Extended PIN

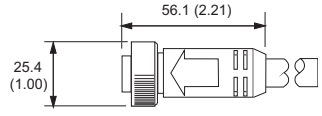
Specifications

Mechanical	
Coupling Nut	Black anodized aluminum
Housing	Black PVC
Insert	Black PVC
Cable Diameter	0.43 in. +/- 0.12 in. (10.9 mm +/- 0.5 mm) with four 16 AWG conductors 0.58 in. +/- 0.12 in. (14.7 mm +/- 0.5 mm) with four 14 AWG conductors
Electrical	
Contacts	Brass with gold over nickel plating
Cable	Black PVC, dual rated UL TC/Open Wiring and STOOW
Cable Rating	600V AC/DC
Assembly Rating	4-pin — 16 AWG, 600V @ 10 A 4-pin — 14 AWG, 600V @ 15 A
Short Circuit Current Rating (SCCR)	**Fusing:** Suitable for use on a circuit capable of delivering not more than 65000 RMS symmetrical amperes at 600V AC maximum when protected by CC, J, and T class fuses, rated 40 A non-time delay or 20 A time delay.
Environmental	
Enclosure Type Rating	IP67, NEMA 4 & 6P; 1200 psi washdown
Operating Temperature	UL Type TC 600V 90 °C Dry 75 °C Wet, Exposed Run (ER) or MTW 600V 90 °C or STOOW 105 °C 600V - CSA STOOW 600V FT2

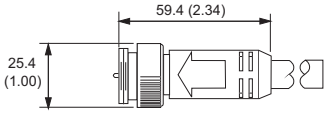
Approximate Dimensions

Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes and are subject to change.

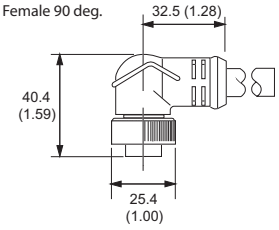
Female straight



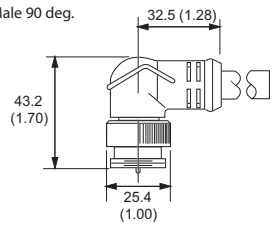
Male straight

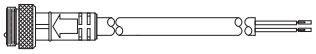


Female 90 deg.

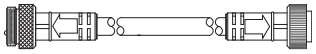


Male 90 deg.





Example of Cordset



Example of Patchcord

Bulletin 280 — Three-Phase Power Tees and Reducers (4-Pole)

- Listed per UL 2237 for use in motor branch circuits per NFPA 79
  - – One-piece molded design
  - – M35 power tee
  - – M35 power tee with M22 reducing drop
  - – M35 to M22 straight reducer
- 4-pin T-port connects a single drop line to the trunk
- 4-pin configuration

Table of Contents

Approximate Dimensions..... 4-100
Accessories..... 4-107

Standards Compliance

UL 2237

Certifications

UL Listed (File No. E318496, Guide PVVA)

Product Selection

Tees and Reducing Adapters ❄

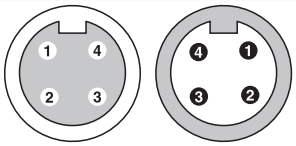
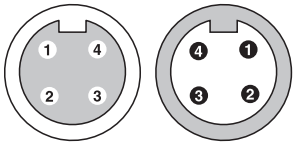
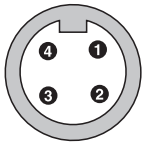
Description	Assembly Rating	Color Code	Cat. No.
M35, 3-Phase Power Tee, 4-pole	25 A	A	**280-T35**
M35, 3-Phase Power Tee Reducing drop M22, 4-pole	Trunk 25 A/Drop 15 A	B	**280-RT35**
M35, 3-Phase Reducing Adapter, 4-pole	15 A	C	**280-RA35**

❄ Stainless steel version may be ordered by adding **S** to the cat. no. (Example: Cat. No. 280**S**-T35)

Specifications

Mechanical	
Coupling Nut	Black anodized aluminum (Trunk), black zinc diecast (Drop)
Housing	Black PVC
Insert	Black PVC
Electrical	
Contacts	Copper alloy with gold over nickel plating
Voltage	600V AC/DC
Assembly Rating	Trunk Tee: 25 A Reducing Tee: Trunk 25 A/Drop 15 A Reducer: 15 A
Short Circuit Current Rating (SCCR)	*Trunk Tee* **Fusing:** Suitable for use on a circuit capable of delivering not more than 65000 RMS Symmetrical Amperes at 600V AC maximum when protected by CC, J, and T class fuses **Circuit Breaker:** Suitable for use on a circuit capable of delivering not more than 65000 RMS Symmetrical Amperes at 480V AC maximum when protected by Bul. 140U-H frame circuit breaker, not rated more than 480V, 100 A and a maximum interrupting of 65000 RMS Symmetrical Amperes. *Reducing Tee & Reducer* **Fusing:** Suitable for use on a circuit capable of delivering not more than 65000 RMS Symmetrical Amperes at 600V AC maximum when protected by CC, J, and T class fuses, rated 40 A non-time delay or 20 A time delay.
Environmental	
Enclosure Type Rating	IP67, NEMA 4 & 6P; 1200 psi washdown

Pinout and Color Code

Assembly Rating	Color Code	Face View Pinout — 4-Pin, M35 Connector	Face View Pinout — 4-Pin, M22 Connector
Trunk Tee: 25 A	A	 Female Male 1 Black 2 Green/Yellow Extended PIN 3 Red 4 White	—
Reducing Tee: Trunk 25 A/ Drop 15 A	B	 Female Male 1 Black 2 Green/Yellow Extended PIN 3 Red 4 White	 Female 1 Black 2 White 3 Red 4 Green/Yellow Extended PIN
Reducer: Trunk 25 A/ Drop 15 A	C	 Male 1 Black 2 Green/Yellow Extended PIN 3 Red 4 White	 Female 1 Black 2 White 3 Red 4 Green/Yellow Extended PIN

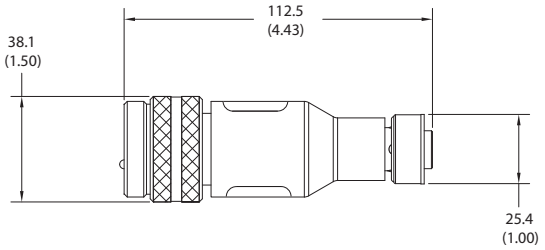
4

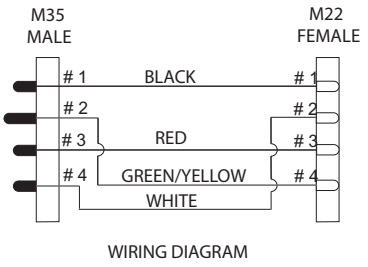
Three-Phase Power Media

Approximate Dimensions

Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes and are subject to change.

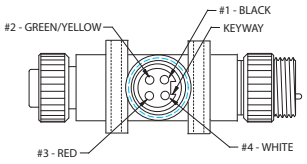
Reducer

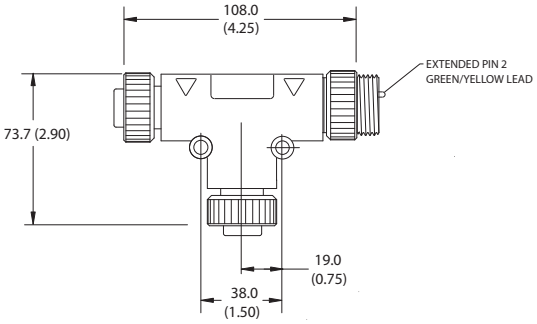


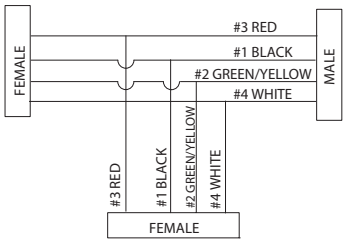


WIRING DIAGRAM

Power Tee

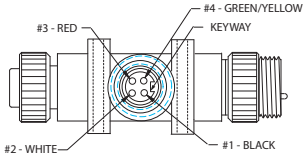


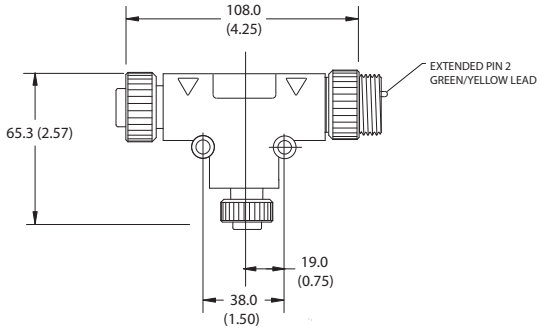


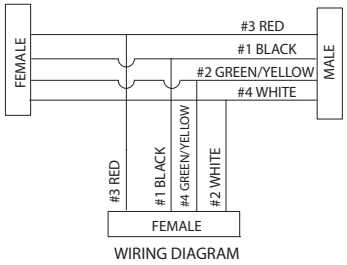


WIRING DIAGRAM

Power Tee - reducing drop







WIRING DIAGRAM

Bulletin 280 — Three-Phase Power Receptacles (Male and Female)

- Listed per UL 2237 for use in motor branch circuits per NFPA 79
- 16, 14, and 10 AWG conductors
- 4-pin configuration, M35 or M22 connection
- Female receptacles can be used for panel mount connection
- Male receptacles can be used for quick disconnect motor junction box
- 1/2 in.-14 NPT threads

Table of Contents

Approximate Dimensions..... 4-102
Additional Accessories..... 4-107

Standards Compliance

UL 2237

Certifications

UL Listed (File No. E318496, Guide PVVA)

Product Selection

Receptacles ❄

Pin Count	Assembly Rating	Color Code	Cat. No.	
			Female	Male
4-pin	16 AWG, 600V, 10 A	A	**280-M22F-M1**	**280-M22M-M1**
	14 AWG, 600V, 15 A	A	280-M24F-M1	280-M24M-M1
	10 AWG, 600V, 25 A	B	**280-M35F-M1**	**280-M35M-M1**

❄ Stainless steel version may be ordered by adding **S** to the cat. no. (Example: Cat. No. 280**S**-M22F-M1)

Accessories

Mounting Nuts and Flat Seals

Description	Pkg. Quantity	Cat. No.
Mounting nuts for 1/2 in.-14 NPT threaded receptacles	10	**889A-U1NUT-10**
Flat sealing washers for 1/2 in.-14 NPT threaded receptacles		**889A-U1FSL-10**

Specifications

Mechanical	
Insert	Black PVC
Receptacle Shell Material	Black anodized aluminum (female) and zinc diecast, black E-coat (male)
Electrical	
Contacts	Copper alloy with gold over nickel plating (Trunk), brass with gold over nickel plating (Drop)
Cable Rating	600V AC/DC
Assembly Rating	4-pin — 16 AWG, 600V @ 10 A 4-pin — 14 AWG, 600V @ 15 A 4-pin — 10 AWG, 600V @ 25 A
Short Circuit Current Rating (SCCR)	*4-pin — 14 or 10 AWG* **Fusing:** Suitable for use on a circuit capable of delivering not more than 65000 RMS Symmetrical Amperes at 600V AC maximum when protected by CC, J, and T class fuses **Circuit Breaker:** Suitable for use on a circuit capable of delivering not more than 65000 RMS Symmetrical Amperes at 480V AC maximum when protected by Bul. 140U-H frame circuit breaker, not rated more than 480V, 100 A and a maximum interrupting of 65000 RMS Symmetrical Amperes. *4-pin — 16 AWG* **Fusing:** Suitable for use on a circuit capable of delivering not more than 65000 RMS Symmetrical Amperes at 600V AC maximum when protected by CC, J, and T class fuses, rated 40 A non-time delay or 20 A time delay.
Environmental	
Enclosure Type Rating	IP67, NEMA 4 & 6P; 1200 psi washdown

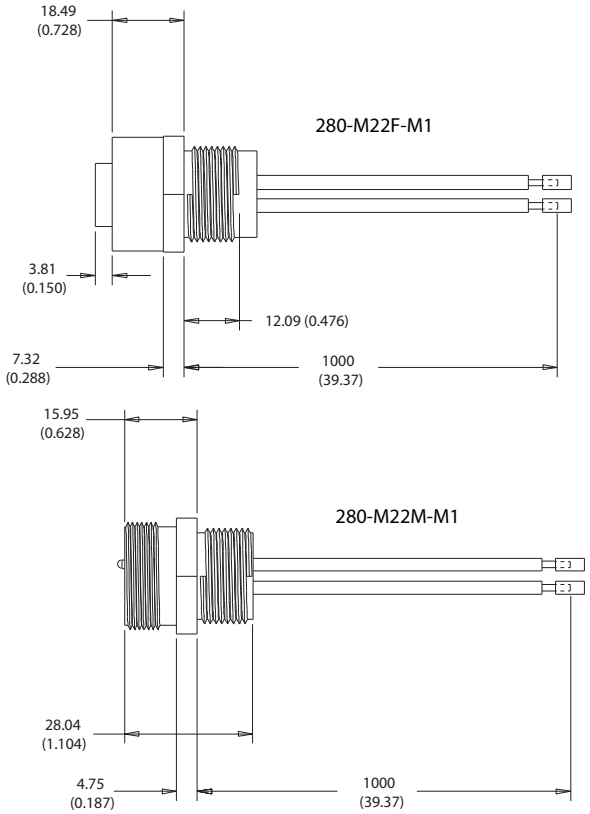
Pinout and Color Code

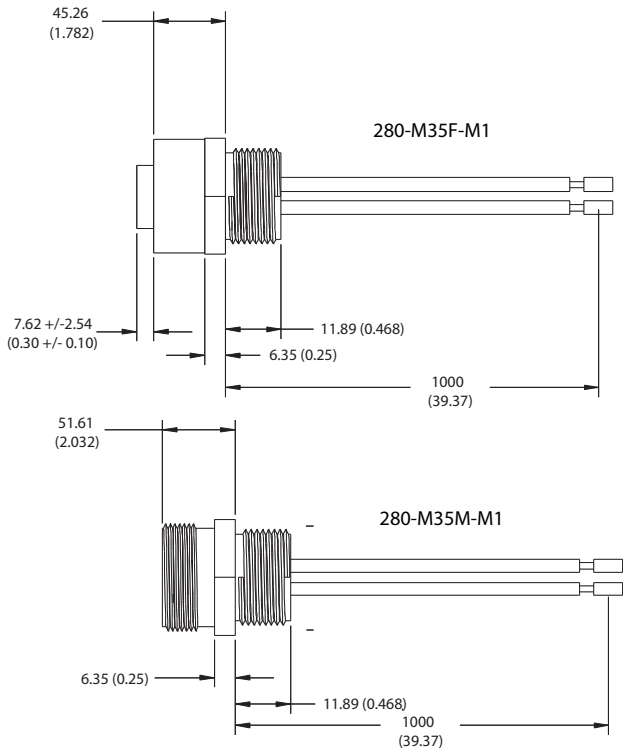
Assembly Rating	Color Code	Face View Pinout, 4-Pin, M35 Connector, Female	Face View Pinout, 4-Pin, M35 Connector, Male	Face View Pinout, 4-Pin, M22 Connector, Female	Face View Pinout, 4-Pin, M22 Connector, Male
14 AWG, 600V, 15 A 16 AWG, 600V, 10 A	A	—		1 Black 2 White	3 Red 4 Green/Yellow Extended PIN
10 AWG, 600V, 25 A	B	1 Black 2 Green/Yellow Extended PIN	3 Red 4 White	—	

Three-Phase Power Media

Approximate Dimensions

Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes and are subject to change.





Bulletin 889N — Control Power Trunk and Drop Cables

- 6-pin/5-used configuration to prevent mis-wiring with network connectors
- One-piece molded design
- 16 AWG exposed run (TC-ER) rated cable

Table of Contents

Accessories..... 4-107

Product Selection

Cordsets

Pin Count	Assembly Rating	Cat. No.			
		Straight Female	Right-Angle Female	Straight Male	Right-Angle Male
6-pin/5 used	16 AWG 600V, 10 A	889N-F65GF-✶	889N-R65GF-✶	889N-M65GF-✶	889N-E65GF-✶

✶ Replace symbol with code from the table below that represents the desired length:

Feet	6.5	16.4	32.8
Meters	2	5	10
Code	2	5	10

Patchcords

Pin Count	Assembly Rating	Cat. No.			
		Straight Female Straight Male	Right-Angle Female Straight Male	Straight Female Right-Angle Male	Right-Angle Female Right-Angle Male
6-pin/5 used	16 AWG 600V, 10 A	889N-F65GFNM-❄	889N-R65GFNM-❄	889N-F65GFNE-❄	889N-R65GFNE-❄

❄ Replace symbol with code from the table below that represents the desired length:

Feet	3.3	6.5	9.8	16.4	32.8
Meters	1	2	3	5	10
Code	1	2	3	5	10

Specifications

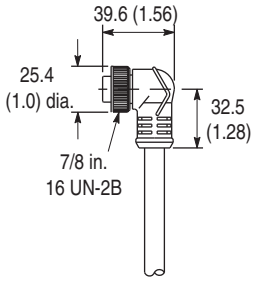
Mechanical	
Coupling Nut	Black epoxy coated zinc
Overmold	Black Riteflex TPE
Insert	Yellow Riteflex TPE
Contacts	Brass/gold over palladium nickel
Cable	Grey PVC, 16 AWG, dual rated UL TC/Open Wiring and STOOW
Cable Diameter	0.44 in. +/- 0.12 in. (11.18 mm +/- 0.5 mm)
Electrical	
Cable Rating	UL Type TC 600V 90 °C Dry 75 °C Wet, Open Wiring or MTW 600V 90 °C or STOOW 105 °C 600V - CSA STOOW 600V FT2
Assembly Rating	600V, 10 A
Environmental	
Enclosure Type Rating	IP67, NEMA 6P, 1200 psi washdown
Operating Temperature	-20…+90 °C (-4…+194 °F)

Pinout and Color Code

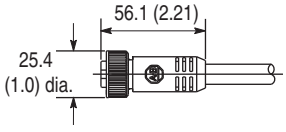
	Face View Pinout	
	6-pin/5-used	
	Female	Male
Color Code	1 Red (+) 2 Black (-) 3 Green (GND)	4 Blank/Not Used 5 Blue (S1) 6 White (S2)

Approximate Dimensions

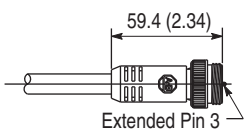
Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes and are subject to change.



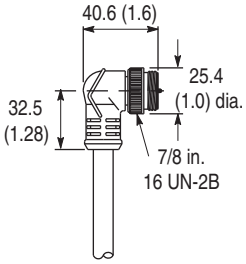
Female 90 Deg.



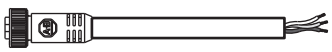
Female Straight



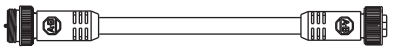
Male Straight



Male 90 Deg.



Example of Cordset



Example of Patchcord

Bulletin 898N — Control Power T-Ports

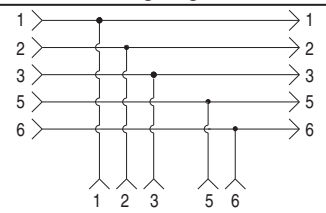
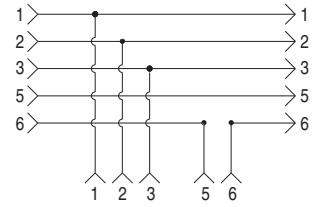
- 6-pin/5-used configuration to prevent mis-wiring with network connectors
- One piece molded design
- Durable compact design

Table of Contents

Accessories..... 4-107

Product Selection

T-Ports

Configuration	Assembly Rating	Overmold Color	Wiring Diagram	Cat. No.
E-stop out	600V, 10 A	Red		**898N-653ES-NKF**
E-stop in	600V, 10 A	Black		**898N-653ST-NKF**

Specifications

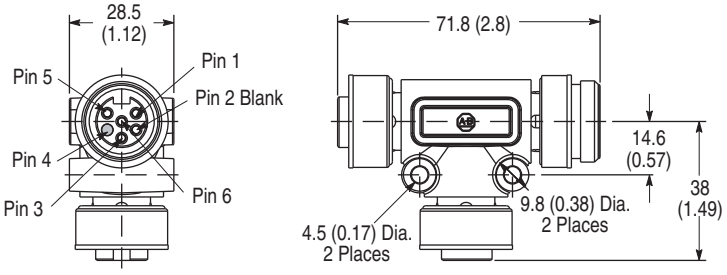
Mechanical	
Coupling Nut	Black epoxy coated zinc
Housing	Riteflex TPE
Insert	Yellow Riteflex TPE
Contacts	Brass/gold over palladium nickel
Electrical	
Assembly Rating	600V, 10 A
Environmental	
Enclosure Type Rating	IP67, NEMA 6P, 1200 psi washdown
Operating Temperature	-20…+90 °C (-4…+194 °F)

Pinout and Color Code

	Face View Pinout	
	6-pin/5-used	
	Female	Male
Color Code	1 Red 2 Black 3 Green	4 Blank/Not Used 5 Blue 6 White

Approximate Dimensions

Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes and are subject to change.



Bulletin 888N — Control Power Receptacles

- 6-pin/5-used configuration to prevent mis-wiring with network connectors
- 1/2 in. - 14 NPT threads

Table of Contents

Accessories..... 4-107

Product Selection

Receptacles

Pin Count	Assembly Rating	Cat. No.	
		Female	Male
6-pin/5 used	16 AWG 600V, 10 A	888N-D65AF1-∗	888N-M65AF1-∗

∗ Replace symbol with length in meters (0.3 or 1 standard)

Specifications

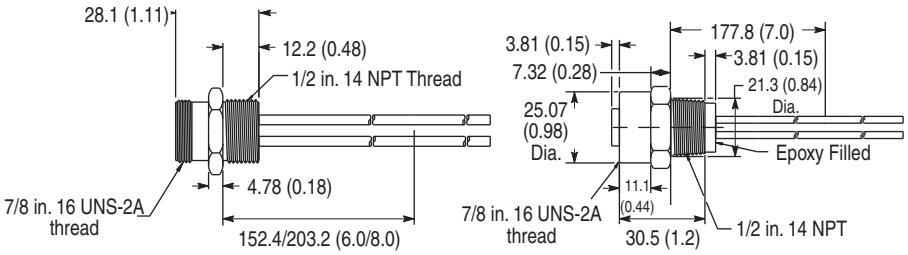
Mechanical	
Receptacle Shell	Male: Black epoxy coated zinc diecast Female: Black anodized aluminum
Insert	Yellow PVC
Contacts	Brass/gold over palladium nickel
Electrical	
Assembly Rating	600V, 10 A
Environmental	
Enclosure Type Rating	IP67, NEMA 6P, 1200 psi washdown
Operating Temperature	-20…+90 °C (-4…+194 °F)

Pinout and Color Code

	Face View Pinout	
	6-pin/5-used	
	Female	Male
Color Code	1 Red (+) 2 Black (-) 3 Green (GND)	4 Blank/Not Used 5 Blue (S1) 6 White (S2)

Approximate Dimensions

Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes and are subject to change.



Bulletin 889A — Control Power Shorting Plugs

- 6-pin/5-used configuration to prevent mis-wiring with network connectors
- 1/2 in. - 14 NPT threads

Table of Contents

Accessories..... 4-107

Product Selection

Shorting Plugs

Configuration	Assembly Rating	Overmold Color	Wiring Diagram	Cat. No.
E-stop out	600V, 10 A	Red	1. ← 2. ← N/C 3. ← N/C 4. ← Blank 5. ← N/C 6. ←	**889A-M65SP61**
E-stop in		Black	1. ← N/C 2. ← N/C 3. ← N/C 4. ← Blank 5. ← 6. ←	**889A-M65SP65**

Specifications

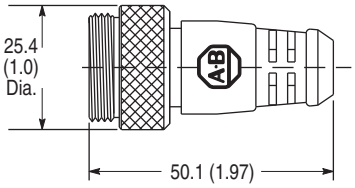
Mechanical	
Coupling Nut	Black epoxy coated zinc
Overmold	Riteflex TPE
Insert	Yellow Riteflex TPE
Contacts	Brass/gold over palladium nickel
Electrical	
Assembly Rating	600V, 10 A
Environmental	
Enclosure Type Rating	IP67, NEMA 6P, 1200 psi washdown
Operating Temperature	-20…+90 °C (-4…+194 °F)

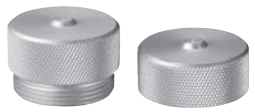
Pinout and Color Code

	Face View Pinout	
	6-pin/5-used	
	Female	Male
Color Code	1 Red (+) 2 Black (-) 3 Green (GND)	4 Blank/Not Used 5 Blue (S1) 6 White (S2)

Approximate Dimensions

Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes and are subject to change.





Specifications

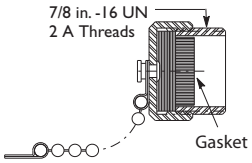
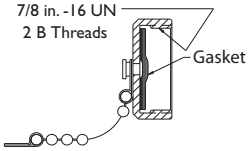
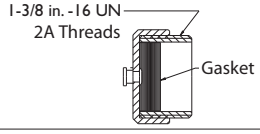
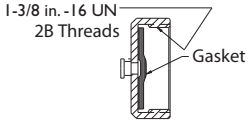
	Locking Clips	Sealing Caps
Mechanical		
Material	ABS/PC plastics	Anodized aluminum
Color	Black	Grey
Electrical		
	Non-current carrying, no ratings required	
Environmental		
Enclosure Type Rating	No rating required	IP67, NEMA 4 & 6P; 1200 psi washdown

Product Selection

Locking Clips

Description	Pkg. Quantity	Connector Style	Cat. No.
Clam shell design clips over the three-phase power media drop connection, to limit customer access.	10	M22 Connector	280-MTRLC-M22
Clam shell design clips over the three-phase power media trunk connection, to limit customer access.		M35 Connector	280-MTRLC-M35

Sealing Caps

Connector Style	Material	Thread Configuration	Dimensions	Cat. No.
Control Power (M22)	Aluminum grey, anodized	External, male		**1485A-C1**
		Internal, female		**889A-NCAP**
3-Phase Power (M35)		External, male		**889A-QMCAP**
		Internal, female		889A-QCAP

Mounting Nuts and Flat Seals

Description	Pkg. Quantity	Cat. No.
Mounting nuts for 1/2 in.-14 NPT threaded receptacles	10	**889A-U1NUT-10**
Flat sealing washers for 1/2 in.-14 NPT threaded receptacles		**889A-U1FSL-10**

On-Machine E-Stop Stations

Enclosure Type	Quick Connect	Knockout Type	Operator	Illumination Voltage	Contact Configuration	Cat. No.
Plastic	Mini Receptacle	Metric	Twist-to-Release 40 mm	24V AC/DC	1 N.O./1 N.C.	800F-1YMQ4
				120V AC		800F-1YMQ5
				240V AC		800F-1YMQ6
Metal				24V AC/DC		800F-1MYMQ4
				120V AC		800F-1MYMQ5
				240V AC		800F-1MYMQ6

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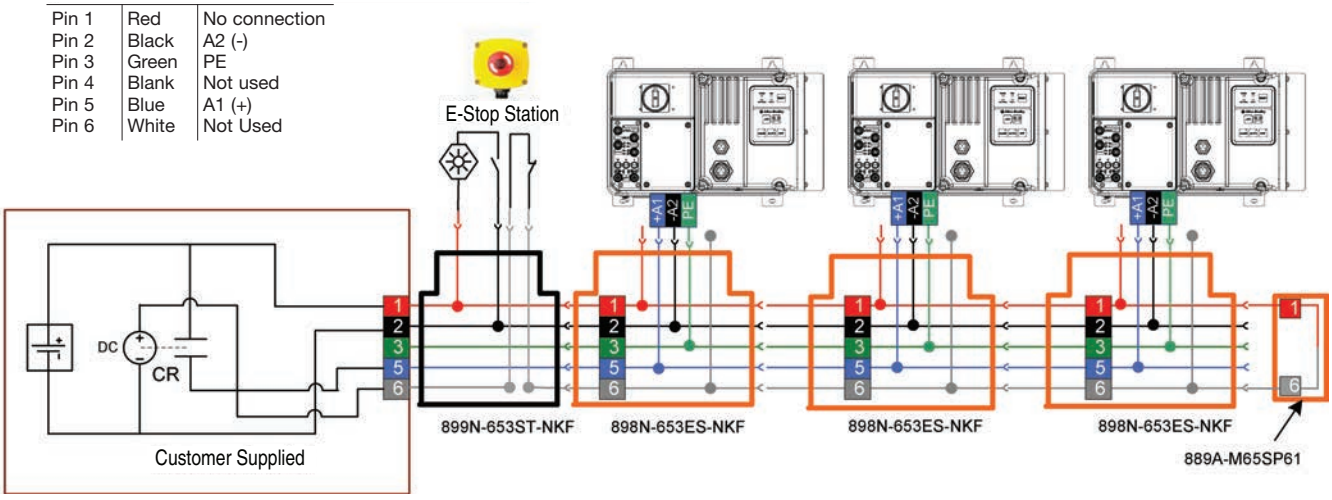
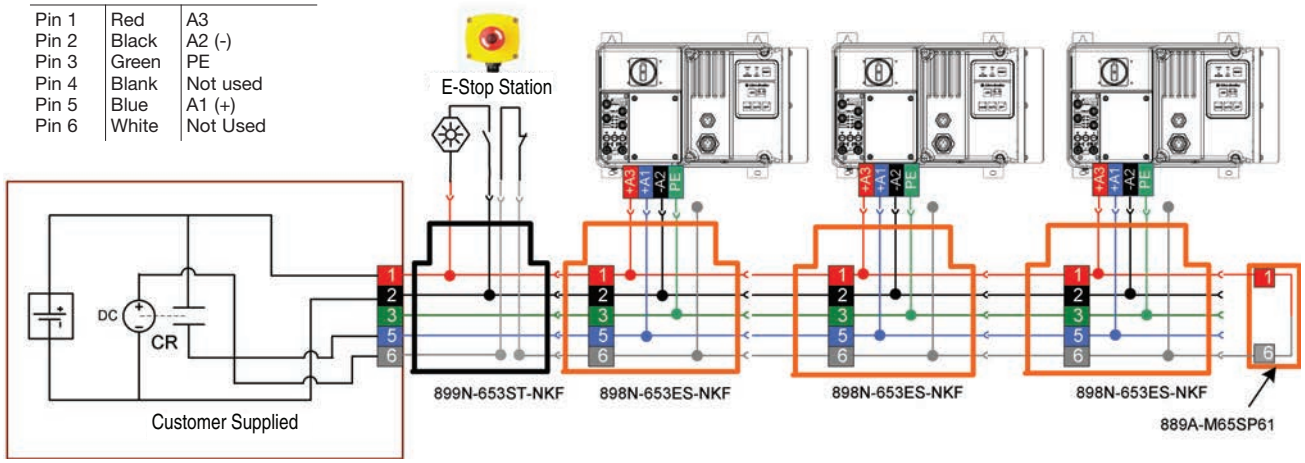
Example E-Stop Circuit for DeviceNet/ArmorPoint Bus Version

Pin 1	Red	No connection
Pin 2	Black	A2 (-)
Pin 3	Green	PE
Pin 4	Blank	Not used
Pin 5	Blue	A1 (+)
Pin 6	White	Not Used



Example E-Stop Circuit for EtherNet/IP Bus Version

Pin 1	Red	A3
Pin 2	Black	A2 (-)
Pin 3	Green	PE
Pin 4	Blank	Not used
Pin 5	Blue	A1 (+)
Pin 6	White	Not Used



Bulletin 150 — Solid-State Reduced Voltage Starters

The Allen-Bradley SMC™ Smart Motor Controller product line offers a broad range of products for starting and stopping standard 3-phase squirrel-cage induction motors and wye-delta motors.

	SMC™-50	SMC™ Flex	SMC™-3	SMC™ Dialog Plus	STC™	
Features	200…690V 90…xxx A♣	200…690V 1…1250 A	200…600V 1…480 A	200…600V 1…1000 A	100…240V 1Ø, 1…22 A	200…600V 3Ø, 1…22 A
Soft Start	S	S	S	S	S	S
Kickstart	S	S	S	S	—	—
Current Limit	S	S	S	S	—	—
Dual Ramp Start	S	S	—	S	—	—
Full Voltage	S	S	—	S	—	—
Energy Saver	S	—	—	S	—	—
Soft Stop	S	S	S	O	—	—
Pump Control	S	O	—	O	—	—
Preset Slow Speed	S	S	—	O	—	—
Linear Acceleration/Deceleration	S	S	—	—	—	—
Torque Control	S	—	—	—	—	—
SMB™ Smart Motor Braking	S	O	—	O	—	—
Accu-Stop™	S	O	—	O	—	—
Slow Speed with Braking	S	O	—	O	—	—
Integrated Bypass Contactor	NA⌘	S	S	NA⌘	—	—
Integrated Motor Overload Protection	S	S	S	S	—	—
Single-phase Operation	—	—	—	—	S	—
DPI Communication	S	S	—	—	—	—
Metering	S	S	—	S	—	—
Real Time Clock	S	—	—	—	—	—
Motor Winding Heater Function	S	❄	—	—	—	—
Diagnostic Faults and Alarms	S	S	—	—	—	—
Motor and Starter	S	—	—	—	—	—
Individual Bit Enable of Faults and Alarms	S	—	—	—	—	—
Automatic Tuning of Motor Parameters	S	—	—	—	—	—
Parameter Configuration/Programming	S✶	S	—	S	—	—
Human Interface Module (HIM)	O✶	O	—	—	—	—
Parameter Configuration Module	O✶	—	—	—	—	—
Configuration Software: Drives Explorer and Drives Executive	O✶	O	—	—	—	—
Digital I/O Expansion Module‡§	O	—	—	—	—	—
Ground Fault/CT/PTC Module‡	O	—	—	—	—	—
Network Communications	O	O	—	—	—	—
Inside Delta Connection	S	S	S	—	—	—
Standards Compliance: CE Marked per Low Voltage Directive 73/23/EEC, 93/68/EEC CSA Certified (File No. LR 1234) UL Listed (File No. E96956)	S	S	S	S	S	S
Product Selection	Page 4-115Web♣	Page 4-115	Page 4-138	Open Style: Page 4-162 Enclosed: Web❖	Web❖	

S = Standard Feature
O = Optional Feature

‡ With removable terminal block.
§ Starter ships with 2 DC inputs and 2 relay outputs as standard.
✶ Starter does not include a configuration device as standard.
❄ Option using a Bulletin 1410 motor winding heater.
⌘ The starter is fully solid-state (no integral bypass). An external bypass contactor can be added as an option.
❖ Note: Information for this product line is available on the Industrial Controls catalog web site: www.ab.com/catalogs.
♣ Note: Information for this product line is available in publication 150-SG010* or on the Industrial Controls catalog web site:

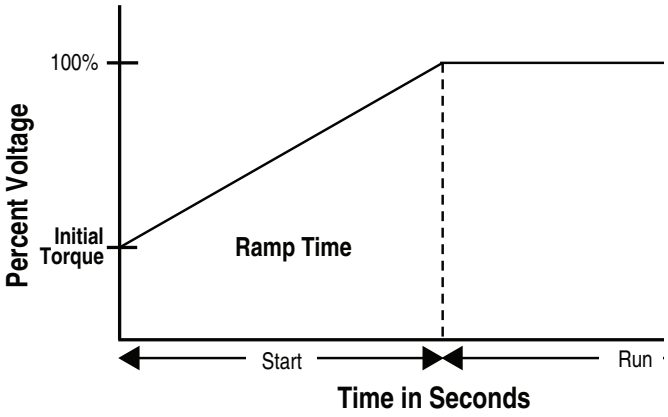
4

Modes of Operation

The SMC controllers provide the following modes of operation:

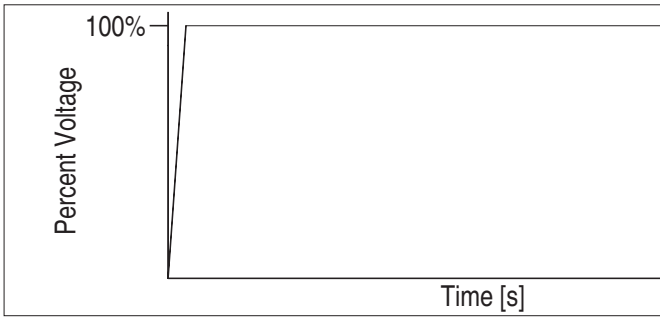
Soft Start

This method covers the most general applications. The motor is given an initial torque setting, which is user adjustable. From the initial torque level, the output voltage to the motor is steplessly increased during the acceleration ramp time, which is user adjustable.



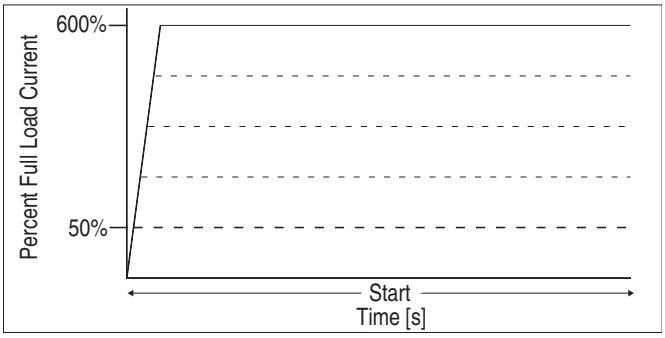
Full Voltage Start

This method is used in applications requiring across-the-line starting. The SMC controller performs like a solid-state contactor. Full inrush current and locked-rotor torque are realized. The SMC may be programmed to provide full voltage start in which the output voltage to the motor reaches full voltage.



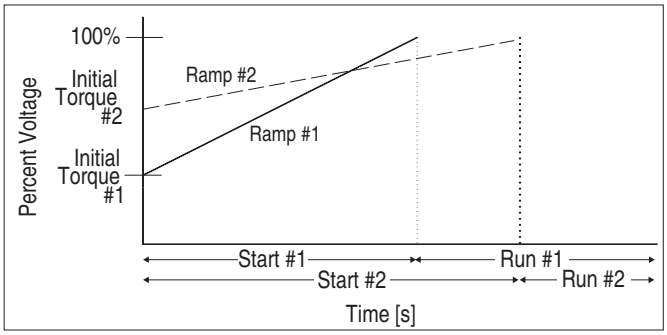
Current Limit Start

This method provides current limit start and is used when it is necessary to limit the maximum starting current. The starting current is user adjustable. The current limit stating time is user adjustable.



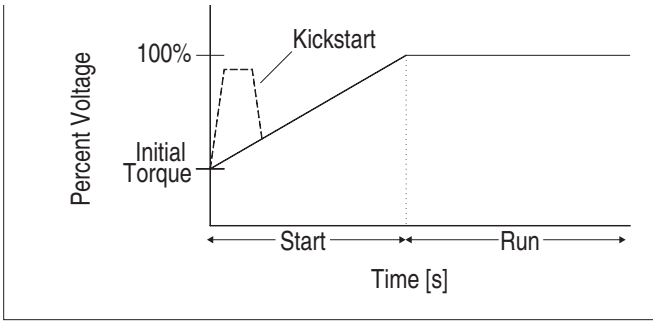
Dual Ramp Start

This starting method is useful on applications with varying loads, starting torque, and start time requirements. Dual Ramp Start offers the user the ability to select between two separate start profiles with separately adjustable ramp times and initial torque settings.



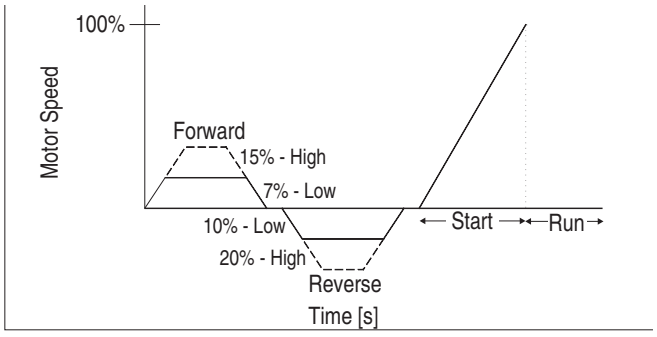
Selectable Kickstart

The kickstart feature provides a boost at startup to break away loads that may require a pulse of high torque to get started. It is intended to provide a current pulse, for a selected period of time.



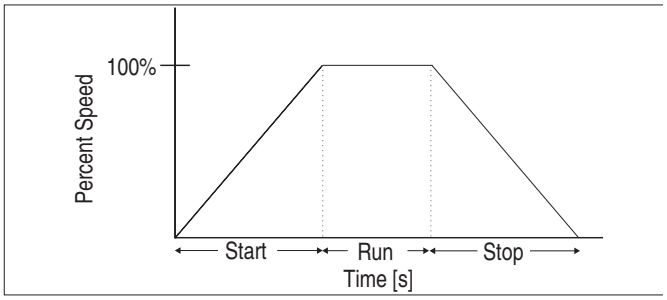
Preset Slow Speed

This method can be used on applications that require a slow speed for positioning material. The Preset Slow Speed can be set for either Low, 7% of base speed, or High, 15% of base speed. Reversing is also possible through programming. Speeds provided during reverse operation are Low, 10% of base speed, or High, 20% of base speed.



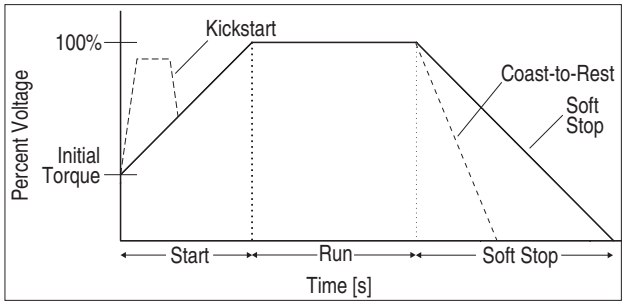
Linear Speed Acceleration

With this type of acceleration mode, a closed-loop feedback system maintains the motor acceleration at a constant rate. The required feedback signal is provided by a DC tachometer coupled to the motor (tachometer supplied by user 0…5V DC, 4.5V DC = 100% speed). Kickstart is available with this mode.



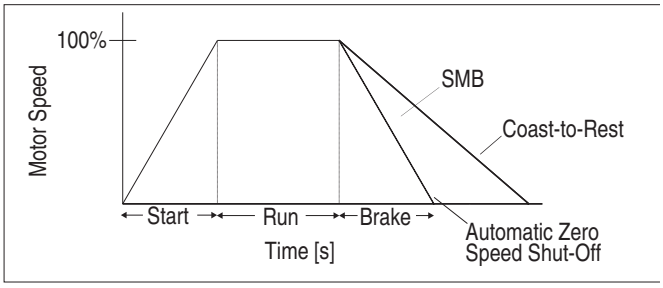
Soft Stop❄

The Soft Stop option can be used in applications requiring an extended coast-to-rest. The voltage ramp down time is user adjustable. The load will stop when the voltage drops to a point where the load torque is greater than the motor torque.



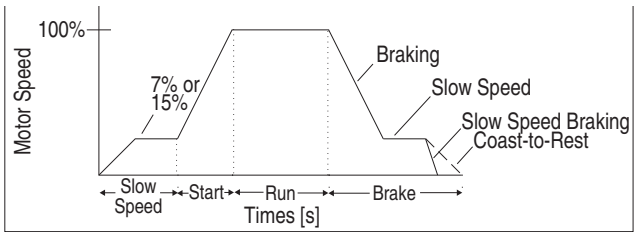
SMB Smart Motor Braking❄

This option provides motor braking for applications that require the motor to stop faster than a coast to rest. Braking control, with automatic zero speed shut off, is fully integrated into the compact design of the SMC controller. This design facilitates a clean, straight forward installation and eliminates the requirement for additional hardware such as braking contactors, resistors, timers, and speed sensors. The microprocessor based braking system applies braking current to a standard squirrel-cage induction motor. The strength of the braking current is user programmable.



Accu-Stop❄

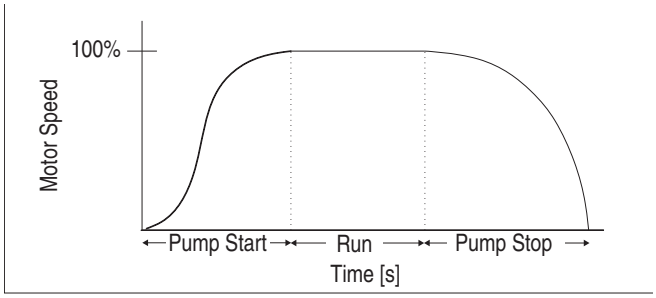
This option is used in applications requiring controlled position stopping. During stopping, braking torque is applied to the motor until it reaches preset slow speed (7% or 15% of rated speed) and holds the motor at this speed until a stop command is given. Braking torque is then applied until the motor reaches zero speed. Braking current and slow speed current are user programmable. Slow speed can be programmed for either 7% (low) or 15% (high).



Pump Control

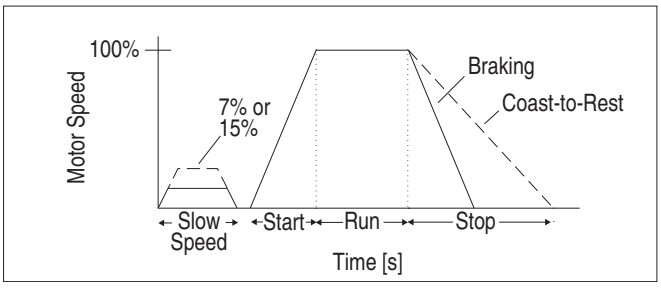
Start and Stop❄

This option is used to reduce surges during the starting and stopping of a centrifugal pump by smoothly accelerating and decelerating the motor. The microprocessor analyzes the motor variables and generates commands which control motor torque and reduce the possibility of surges occurring in the system.



Slow Speed with Braking❄

Slow Speed with Braking is used on applications that require slow speed (in the forward direction) for positioning or alignment and also require braking control to stop. Slow speed adjustments are 7% (low) or 15% (high) of rated speed. Slow speed acceleration current, slow speed running current, and braking current are all adjustable.



❄ Not intended to be used as an emergency stop. Refer to the applicable standards for emergency stop requirements.

Bulletin 150 — SMC™ Flex Smart Motor Controller

The SMC Flex controller provides microprocessor controlled starting for standard 3-phase squirrel-cage induction or Wye-Delta (6-lead) motors. Seven standard modes of operation are available within a single controller.

- 1…1250 A Range
- Seven Standard Start Modes
- Options Include Pump Control and Braking Control

Features

- Built in SCR Bypass/Run Contactor
- Built in Electronic Motor Overload Protection
- CT on each Phase
- Metering
- DPI Communication
- LCD Display
- Keypad Programming
- Four Programmable Auxiliary Contacts

The SMC Flex controller is available for motors rated 1…1250 A; 200…480V AC, 200…600V AC, or 230…690V AC, 50/60 Hz. In addition to motors, the SMC Flex controller can be used to control resistive loads.

Table of Contents

Features..... this page
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Approx. Dims. 4-133

4

This catalog product information is based on the **minimum** information needed to select an SMC soft starter for applications with low starting torque requirements. For product selection involving loads with high starting torque requirements (large fan, rock crusher, chipper, etc.), use of the free tools available from the Rockwell Automation Website is recommended:

http://www.ab.com/industrialcontrols/products/solid-state_motor_control/software/

Standards Compliance

UL 508
CSA C22.2 No.14
EN/IEC 60947-1
EN/IEC 60947-4-2

Certifications

cULus Listed (Open Type) (File No. E96956, Guides NMFT, NMFT7)
CSA Certified (File No. LR 1234)
CE Marked
CCC Certified

Modes of Operation

The SMC Flex controller provides the following modes of operation as standard:

- Soft Start
- Selectable Kickstart
- Current Limit Start
- Dual Ramp Start
- Full Voltage Start
- Linear Speed Acceleration
- Preset Slow Speed
- Soft Stop

Optional Modes of Operation

Pump Control

- Start and Stop

Braking Control

- SMB — Smart Motor Braking
- Accu-Stop
- Slow Speed with Braking

Note: For detailed information about the different modes of operation, see page 4-109.

Description of Features

Electronic Motor Overload Protection
The SMC Flex controller incorporates, as standard, electronic motor overload protection. This overload protection is accomplished electronically with an I^2t algorithm.
When coordinated with the proper short-circuit protection, overload protection is intended to protect the motor, motor controller, and power wiring against overheating caused by excessive overcurrent.
The SMC Flex controller meets applicable requirements as a motor overload protective device.
The controller's overload protection is programmable, providing the user with flexibility. The overload trip class consists of either OFF, 10, 15, 20, or 30 protection. The trip current is programmed by entering the motor full-load current rating, service factor, and selecting the trip class.
Thermal memory is included to accurately model motor operating temperature. Ambient temperature insensitivity is inherent in the electronic design of the overload.

Undervoltage Protection
The SMC Flex controller's undervoltage protection will halt motor operation if a drop in the incoming line voltage is detected.
The undervoltage trip level is adjustable as a percentage of the programmed line voltage, from 0…99%. To eliminate nuisance trips, a programmable undervoltage trip delay time of 0…99 seconds can also be programmed. The line voltage must remain below the undervoltage trip level during the programmed delay time.

Overvoltage Protection
If a rise in the incoming line voltage is detected, the SMC Flex controller's overvoltage protection will halt motor operation.
The overvoltage trip level is adjustable as a percentage of the programmed line voltage, from 0…199%. To eliminate nuisance trips, a programmable overvoltage trip delay time of 0…99 seconds can also be programmed. The line voltage must remain above the overvoltage trip level during the programmed delay time.

Stall Protection and Jam Detection
Motors can experience locked-rotor currents and develop high torque levels in the event of a stall or a jam. These conditions can result in winding insulation breakdown or mechanical damage to the connected load. The SMC Flex controller provides both stall protection and jam detection for enhanced motor and system protection. Stall protection allows the user to program a maximum stall protection delay time from 0…10 seconds. The stall protection delay time is in addition to the programmed start time and begins only after the start time has timed out. If the controller senses that the motor is stalled, it will shut down after the delay period has expired. Jam detection allows the user to determine the motor jam detection level as a percentage of the motor's full-load current rating. To prevent nuisance tripping, a jam detection delay time, from 0.0…99.0 seconds, can be programmed. This allows the user to select the time delay required before the SMC Flex controller will trip on a motor jam condition. The motor current must remain above the jam detection level during the delay time. Jam detection is active only after the motor has reached full speed.

Underload Protection
Utilizing the underload protection of the SMC Flex controller, motor operation can be halted if a drop in current is sensed.
The SMC Flex controller provides an adjustable underload trip setting from 0…99% of the programmed motor full-load current rating with an adjustable trip delay time of 0…99 seconds.

Voltage Unbalance Protection
Voltage unbalance is detected by monitoring the 3-phase supply voltage magnitudes in conjunction with the rotational relationship of the three phases. The controller will halt motor operation when the calculated voltage unbalance reaches the user-programmed trip level.
The voltage unbalance trip level is programmable from 0…25% unbalance.

Excessive Starts Per Hour
The SMC Flex controller allows the user to program the allowed number of starts per hour (up to 99). This helps eliminate motor stress caused by repeated starting during a short time period.

Metering
Power monitoring parameters include:

- 3-phase current
- 3-phase voltage
- Power in kW or mW
- Power usage in kWH or mWH
- Power Factor
- Motor thermal capacity usage
- Elapsed time

Note: The motor thermal capacity usage allows the user to monitor the amount of overload thermal capacity usage before the SMC Flex controller's built-in electronic overload trips.

Built-in DPI Communication Capabilities
A serial interface port is provided as standard, which allows connection to a Bulletin 20 Human Interface Module and a variety of Bulletin 20-COMM Communication Modules. This includes Allen-Bradley Remote I/O, DeviceNet, ControlNet, Ethernet, ProfiBUS, Interbus, and RS485-DF1.

LCD Display
The SMC Flex controller's three-line 16-character backlit LCD display provides parameter identification using clear, informative text. Controller set up can be performed quickly and easily without the use of a reference manual. Parameters are arranged in an organized four-level menu structure for ease of programming and fast access to parameters.

Network I/O
The SMC Flex can have up to two inputs and four outputs controlled via a communication network. The output contacts use the auxiliary contacts.

Keypad Programming
Programming of parameters is accomplished through a five-button keypad on the front of the SMC Flex controller. The five buttons include up and down arrows, an Enter button, a Select button, and an Escape button. The user needs only to enter the correct sequence of keystrokes for programming the SMC Flex controller.

Auxiliary Contacts
Four fully programmable hard contacts are furnished as standard with the SMC Flex controller:

Aux #1, Aux #2, Aux #3, Aux #4

- N.O./N.C.
- Normal/Up-to-Speed/External Bypass/Fault/Alarm/Network

Ground Fault Input
The SMC Flex can monitor for ground fault conditions. An external core balance current transformer is required for this function. See SMC Flex User Manual for additional information.

Tach Input
A motor tachometer is required for the Linear Speed Start mode. Please see the Specifications section on page 4-127 for tachometer characteristics.

PTC Input
A motor PTC input can be monitored by the SMC Flex. In the event of a fault, the SMC Flex will shut down and indicate a motor PTC fault.

Open and Non-Combination

150 – F135 F B D B – 8L
a b c d e f g

a

Bulletin Number	
Code	Description
150	Solid-State Controller
150B	Enclosed Solid-State Controller with Isolation Contactor

b

Controller Ratings	
Code	Description
F5	5 A, 3 Hp @ 460V AC
F25	25 A, 15 Hp @ 460V AC
F43	43 A, 30 Hp @ 460V AC
F60	60 A, 40 Hp @ 460V AC
F85	85 A, 60 Hp @ 460V AC
F108	108 A, 75 Hp @ 460V AC
F135	135 A, 100 Hp @ 460V AC
F201	201 A, 150 Hp @ 460V AC
F251	251 A, 200 Hp @ 460V AC
F317	317 A, 250 Hp @ 460V AC
F361	361 A, 300 Hp @ 460V AC
F480	480 A, 400 Hp @ 460V AC
F625	625 A, 500 Hp @ 460V AC
F780	780 A, 600 Hp @ 460V AC
F970	970 A, 800 Hp @ 460V AC
F1250	1250 A, 1000 Hp @ 460V AC

c

Enclosure Type	
Code	Description
F	NEMA Type 4/12 (IP65) (Non-Combination Only)
J	NEMA Type 12 (IP54)
N	Open

d

Input Line Voltage	
Open Type	
Code	Description
B	200…460V AC, 3-phase, 50 and 60 Hz
C	200…575V AC, 3-phase, 50 and 60 Hz
Z	230…690V AC, 3-phase, 50 and 60 Hz (Open Only, 108 A and above)
Non-Combination Enclosed Only	
H	200…208V AC, 3-phase, 50 and 60 Hz
A	230V AC, 3-phase, 50 and 60 Hz
B	400…460V AC, 3-phase, 50 and 60 Hz
C	500…575V AC, 3-phase, 50 and 60 Hz

e

Control Voltage	
Code	Description
D	100…240V AC (5…480 A units)
R	24V AC/DC (5…480 A units) (Open Only)
E	110/120V AC (625…1250 A units)
A	230/240V AC (625…1250 A units)

f

Options (Select Only One)	
Code	Description
Blank	Standard
B	Pump Control
D	Braking Control

g

Options (Non-Combination only) (see page 4-125 for a full listing)	
Code	Description
8L	Line-Mounted Protective Module (enclosed only)
8M	Load-Mounted Protective Module (enclosed only)
8B	Line- and Load-Mounted Protective Modules (enclosed only)
Load-side MOVs are not available with Pump and Braking options, or on delta-connected motors. MOVs can be field installed for open type units.	

Combination

152H – F480 F BD B – 59 – 8B
a b c d e f g

a

Bulletin Number	
Code	Description
152H	Solid-State Controller with Fusible Disconnect
152B	Solid-State Controller with Fusible Disconnect and Isolation Contactor
153H	Solid-State Controller with Circuit Breaker
153B	Solid-State Controller with Circuit Breaker and Isolation Contactor

b

Controller Ratings	
Code	Description
F5	5 A, 3 Hp @ 460V AC
F25	25 A, 15 Hp @ 460V AC
F43	43 A, 30 Hp @ 460V AC
F60	60 A, 40 Hp @ 460V AC
F85	85 A, 60 Hp @ 460V AC
F108	108 A, 75 Hp @ 460V AC
F135	135 A, 100 Hp @ 460V AC
F201	201 A, 150 Hp @ 460V AC
F251	251 A, 200 Hp @ 460V AC
F317	317 A, 250 Hp @ 460V AC
F361	361 A, 300 Hp @ 460V AC
F480	480 A, 400 Hp @ 460V AC
F625	625 A, 500 Hp @ 460V AC
F780	780 A, 600 Hp @ 460V AC

c

Enclosure Type	
Code	Description
F	NEMA Type 4/12 (IP65)
J	NEMA Type 12 (IP54)

d

Line Voltage, 120V AC Control Voltage	
Code	Description
HD	200…208V AC, 3-phase, 50 and 60 Hz
AD	230V AC, 3-phase, 50 and 60 Hz
BD	400…460V AC, 3-phase, 50 and 60 Hz
CD	500…575V AC, 3-phase, 50 and 60 Hz

e

Control Options	
Code	Description
Blank	Standard
B	Pump Control
D	Braking Control

g

Options (see page 4-125 for a full listing)	
Code	Description
8L	Line-Mounted Protective Module
8M	Load-Mounted Protective Module
8B	Line- and Load-Mounted Protective Modules
Load-side MOVs are not available with Pump and Braking options, or when used with inside-the-delta connections.	

f

Horsepower									
Cat. No.	Hp Rating	Cat. No.	Hp Rating	Cat. No.	Hp Rating	Cat. No.	Hp Rating	Cat. No.	Hp Rating
33	0.5	39	5	46	40	52	150	60	450
34	0.75	40	7.5	47	50	54	200	61	500
35	1	41	10	48	60	56	250	62	600
36	1.5	42	15	49	75	57	300	63	700
37	2	43	20	50	100	58	350	65	800
38	3	44	25	51	125	59	400	67	1000
—	—	45	30	—	—	—	—	—	—

Open Type and Non-Combination Enclosed (IP65, Type 4/12) Controllers — For use with Line-Connected Motors

Enclosures other than those listed are available; consult your local Rockwell Automation sales office or Allen-Bradley distributor.

Rated Voltage [V AC]	Motor Current [A]❄	Max. kW, 50 Hz	Max. Hp, 60 Hz	Control Power	Open Type — Line-Connected Motors✶	IP65 (Type 4/12) Enclosed Non-Combination Controllers§➢	
					Cat. No.	Cat. No.	
200/208	1…5	—	1	100…240V AC, 50/60 Hz	**150-F5NBD**	150-F5FHD	
				24V AC/DC♣	**150-F5NBR**	—	
	5...25	—	5	100…240V AC, 50/60 Hz	**150-F25NBD**	150-F25FHD	
				24V AC/DC♣	**150-F25NBR**	—	
	8.6...43	—	10	100…240V AC, 50/60 Hz	**150-F43NBD**	150-F43FHD	
				24V AC/DC♣	**150-F43NBR**	—	
	12...60	—	15	100…240V AC, 50/60 Hz	**150-F60NBD**	150-F60FHD	
				24V AC/DC♣	**150-F60NBR**	—	
	17...85	—	25	100…240V AC, 50/60 Hz	**150-F85NBD**	150-F85FHD	
				24V AC/DC♣	**150-F85NBR**	—	
	27…108	—	30	100…240V AC, 50/60 Hz	**150-F108NBD**	150-F108FHD	
				24V AC/DC♣	**150-F108NBR**	—	
	34…135	—	40	100…240V AC, 50/60 Hz	**150-F135NBD**	150-F135FHD	
				24V AC/DC♣	**150-F135NBR**	—	
	67…201	—	60	100…240V AC, 50/60 Hz	**150-F201NBD**	150-F201FHD	
				24V AC/DC♣	**150-F201NBR**	—	
	84…251	—	75	100…240V AC, 50/60 Hz	**150-F251NBD**	150-F251FHD	
				24V AC/DC♣	**150-F251NBR**	—	
	106…317	—	100	100…240V AC, 50/60 Hz	**150-F317NBD**	150-F317FHD	
				24V AC/DC♣	**150-F317NBR**	—	
	120…361	—	125	100…240V AC, 50/60 Hz	**150-F361NBD**	150-F361FHD	
				24V AC/DC♣	**150-F361NBR**	—	
	160…480	—	150	100…240V AC, 50/60 Hz	**150-F480NBD**	150-F480FHD	
				24V AC/DC♣	**150-F480NBR**	—	
	208…625	—	200	110/120V AC, 50/60 Hz	**150-F625NBE**	⌘	150-F625JHE
				230/240V AC, 50/60 Hz	150-F625NBA	⌘	150-F625JHA
	260…780	—	250	110/120V AC, 50/60 Hz	150-F780NBE	⌘	150-F780JHE
				230/240V AC, 50/60 Hz	150-F780NBA	⌘	150-F780JHA
	323…970	—	350	110/120V AC, 50/60 Hz	150-F970NBE	—	
				230/240V AC, 50/60 Hz	150-F970NBA	—	
	416…1250	—	400	110/120V AC, 50/60 Hz	150-F1250NBE	—	
				230/240V AC, 50/60 Hz	150-F1250NBA	—	

✶ Controllers rated 108 A and greater are not equipped with line and load terminal lugs. See page 4-126 for terminal lug kits.

❄ Motor FLA rating should fall within specified current range for unit to operate properly. Special consideration should be given when using a motor with a potentially high starting current (greater than ten times motor FLA) with the SMC Flex in the "Full Voltage" starting mode. Contact Rockwell Automation technical support for further guidance.

§ These controllers require a separate 100…240V, 50/60 Hz single-phase control source. To add a control circuit transformer to the enclosure, add the appropriate option code to the catalog string.

♣ Separate 120V or 240V single-phase power supply is required for fan operation.

➢ Line and load termination are provided as standard.

⌘ Available in IP54 (Type 12) enclosure only.

Open Type and Non-Combination Enclosed (IP65, Type 4/12) Controllers — For use with Line-Connected Motors, Continued

Enclosures other than those listed are available; consult your local Rockwell Automation sales office or Allen-Bradley distributor.

Rated Voltage [V AC]	Motor Current [A]❄	Max. kW, 50 Hz	Max. Hp, 60 Hz	Control Power	Open Type — Line-Connected Motors✶	IP65 (Type 4/12) Enclosed Non-Combination Controllers§➢	
					Cat. No.	Cat. No.	
230	1…5	1.1	1	100…240V AC, 50/60 Hz	**150-F5NBD**	150-F5FAD	
				24V AC/DC♣	**150-F5NBR**	—	
	5...25	5.5	7.5	100…240V AC, 50/60 Hz	**150-F25NBD**	150-F25FAD	
				24V AC/DC♣	**150-F25NBR**	—	
	8.6...43	11	15	100…240V AC, 50/60 Hz	**150-F43NBD**	150-F43FAD	
				24V AC/DC♣	**150-F43NBR**	—	
	12...60	15	20	100…240V AC, 50/60 Hz	**150-F60NBD**	150-F60FAD	
				24V AC/DC♣	**150-F60NBR**	—	
	17...85	22	30	100…240V AC, 50/60 Hz	**150-F85NBD**	150-F85FAD	
				24V AC/DC♣	**150-F85NBR**	—	
	27…108	30	40	100…240V AC, 50/60 Hz	**150-F108NBD**	150-F108FAD	
				24V AC/DC♣	**150-F108NBR**	—	
	34…135	37	50	100…240V AC, 50/60 Hz	**150-F135NBD**	150-F135FAD	
				24V AC/DC♣	**150-F135NBR**	—	
	67…201	55	75	100…240V AC, 50/60 Hz	**150-F201NBD**	150-F201FAD	
				24V AC/DC♣	**150-F201NBR**	—	
	84…251	75	100	100…240V AC, 50/60 Hz	**150-F251NBD**	150-F251FAD	
				24V AC/DC♣	**150-F251NBR**	—	
	106…317	90	125	100…240V AC, 50/60 Hz	**150-F317NBD**	150-F317FAD	
				24V AC/DC♣	**150-F317NBR**	—	
	120…361	110	150	100…240V AC, 50/60 Hz	**150-F361NBD**	150-F361FAD	
				24V AC/DC♣	**150-F361NBR**	—	
	160…480	132	200	100…240V AC, 50/60 Hz	**150-F480NBD**	150-F480FAD	
				24V AC/DC♣	**150-F480NBR**	—	
	208…625	200	250	110/120V AC, 50/60 Hz	**150-F625NBE**	⌘	150-F625JAE
				230/240V AC, 50/60 Hz	150-F625NBA	⌘	150-F625JAA
	260…780	250	300	110/120V AC, 50/60 Hz	150-F780NBE	⌘	150-F780JAE
				230/240V AC, 50/60 Hz	150-F780NBA	⌘	150-F780JAA
	323…970	315	400	110/120V AC, 50/60 Hz	150-F970NBE	—	
				230/240V AC, 50/60 Hz	150-F970NBA	—	
	416…1250	400	500	110/120V AC, 50/60 Hz	150-F1250NBE	—	
				230/240V AC, 50/60 Hz	150-F1250NBA	—	

✶ Controllers rated 108 A and greater are not equipped with line and load terminal lugs. See page 4-126 for terminal lug kits.

❄ Motor FLA rating should fall within specified current range for unit to operate properly. Special consideration should be given when using a motor with a potentially high starting current (greater than ten times motor FLA) with the SMC Flex in the "Full Voltage" starting mode. Contact Rockwell Automation technical support for further guidance.

§ These controllers require a separate 100…240V, 50/60 Hz single-phase control source. To add a control circuit transformer to the enclosure, add the appropriate option code to the catalog string.

♣ Separate 120V or 240V single-phase power supply is required for fan operation.

➢ Line and load termination are provided as standard.

⌘ Available in IP54 (Type 12) enclosure only.

Open Type and Non-Combination Enclosed (IP65, Type 4/12) Controllers — For use with Line-Connected Motors, Continued

Enclosures other than those listed are available; consult your local Rockwell Automation sales office or Allen-Bradley distributor.

Rated Voltage [V AC]	Motor Current [A]❄	Max. kW, 50 Hz	Max. Hp, 60 Hz	Control Power	Open Type — Line-Connected Motors✶	IP65 (Type 4/12) Enclosed Non-Combination Controllers§➢	
					Cat. No.	Cat. No.	
400/415/460	1…5	2.2	3	100…240V AC, 50/60 Hz	**150-F5NBD**	150-F5FBD	
				24V AC/DC♣	**150-F5NBR**	—	
	5...25	11	15	100…240V AC, 50/60 Hz	**150-F25NBD**	150-F25FBD	
				24V AC/DC♣	**150-F25NBR**	—	
	8.6...43	22	30	100…240V AC, 50/60 Hz	**150-F43NBD**	150-F43FBD	
				24V AC/DC♣	**150-F43NBR**	—	
	12...60	30	40	100…240V AC, 50/60 Hz	**150-F60NBD**	150-F60FBD	
				24V AC/DC♣	**150-F60NBR**	—	
	17...85	45	60	100…240V AC, 50/60 Hz	**150-F85NBD**	150-F85FBD	
				24V AC/DC♣	**150-F85NBR**	—	
	27…108	55	75	100…240V AC, 50/60 Hz	**150-F108NBD**	150-F108FBD	
				24V AC/DC♣	**150-F108NBR**	—	
	34…135	75	100	100…240V AC, 50/60 Hz	**150-F135NBD**	150-F135FBD	
				24V AC/DC♣	**150-F135NBR**	—	
	67…201	110	150	100…240V AC, 50/60 Hz	**150-F201NBD**	150-F201FBD	
				24V AC/DC♣	**150-F201NBR**	—	
	84…251	132	200	100…240V AC, 50/60 Hz	**150-F251NBD**	150-F251FBD	
				24V AC/DC♣	**150-F251NBR**	—	
	106…317	160	250	100…240V AC, 50/60 Hz	**150-F317NBD**	150-F317FBD	
				24V AC/DC♣	**150-F317NBR**	—	
	120…361	200	300	100…240V AC, 50/60 Hz	**150-F361NBD**	150-F361FBD	
				24V AC/DC♣	**150-F361NBR**	—	
	160…480	250	400	100…240V AC, 50/60 Hz	**150-F480NBD**	150-F480FBD	
				24V AC/DC♣	**150-F480NBR**	—	
	208…625	355	500	110/120V AC, 50/60 Hz	**150-F625NBE**	⌘	150-F625JBE
				230/240V AC, 50/60 Hz	150-F625NBA	⌘	150-F625JBA
	260…780	450	600	110/120V AC, 50/60 Hz	150-F780NBE	⌘	150-F780JBE
				230/240V AC, 50/60 Hz	150-F780NBA	⌘	150-F780JBA
	323…970	560	800	110/120V AC, 50/60 Hz	150-F970NBE	—	
				230/240V AC, 50/60 Hz	150-F970NBA	—	
	416…1250	710	1000	110/120V AC, 50/60 Hz	150-F1250NBE	—	
				230/240V AC, 50/60 Hz	150-F1250NBA	—	

✶ Controllers rated 108 A and greater are not equipped with line and load terminal lugs. See page 4-126 for terminal lug kits.

❄ Motor FLA rating should fall within specified current range for unit to operate properly. Special consideration should be given when using a motor with a potentially high starting current (greater than ten times motor FLA) with the SMC Flex in the "Full Voltage" starting mode. Contact Rockwell Automation technical support for further guidance.

§ These controllers require a separate 100…240V, 50/60 Hz single-phase control source. To add a control circuit transformer to the enclosure, add the appropriate option code to the catalog string.

♣ Separate 120V or 240V single-phase power supply is required for fan operation.

➢ Line and load termination are provided as standard.

⌘ Available in IP54 (Type 12) enclosure only.

Open Type and Non-Combination Enclosed (IP65, Type 4/12) Controllers — For use with Line-Connected Motors, Continued

Enclosures other than those listed are available; consult your local Rockwell Automation sales office or Allen-Bradley distributor.

Rated Voltage [V AC]	Motor Current [A]❄	Max. kW, 50 Hz	Max. Hp, 60 Hz	Control Power	Open Type — Line-Connected Motors✶	IP65 (Type 4/12) Enclosed Non-Combination Controllers§➢	
					Cat. No.	Cat. No.	
500/575	1...5	2.2	3	100...240V AC, 50/60 Hz	**150-F5NCD**	150-F5FCD	
				24V AC/DC♣	**150-F5NCR**	—	
	5...25	15	20	100...240V AC, 50/60 Hz	**150-F25NCD**	150-F25FCD	
				24V AC/DC♣	150-F25NCR	—	
	8.6...43	22	40	100...240V AC, 50/60 Hz	**150-F43NCD**	150-F43FCD	
				24V AC/DC♣	**150-F43NCR**	—	
	12...60	37	50	100...240V AC, 50/60 Hz	**150-F60NCD**	150-F60FCD	
				24V AC/DC♣	**150-F60NCR**	—	
	17...85	55	75	100...240V AC, 50/60 Hz	**150-F85NCD**	150-F85FCD	
				24V AC/DC♣	**150-F85NCR**	—	
	27...108	75	100	100...240V AC, 50/60 Hz	150-F108NCD	150-F108FCD	
				24V AC/DC♣	**150-F108NCR**	—	
	34...135	90	125	100...240V AC, 50/60 Hz	**150-F135NCD**	150-F135FCD	
				24V AC/DC♣	**150-F135NCR**	—	
	67...201	132	200	100...240V AC, 50/60 Hz	**150-F201NCD**	150-F201FCD	
				24V AC/DC♣	**150-F201NCR**	—	
	84...251	160	250	100...240V AC, 50/60 Hz	**150-F251NCD**	150-F251FCD	
				24V AC/DC♣	**150-F251NCR**	—	
	106...317	200	300	100...240V AC, 50/60 Hz	**150-F317NCD**	150-F317FCD	
				24V AC/DC♣	**150-F317NCR**	—	
	120...361	250	350	100...240V AC, 50/60 Hz	**150-F361NCD**	150-F361FCD	
				24V AC/DC♣	**150-F361NCR**	—	
	160...480	315	500	100...240V AC, 50/60 Hz	150-F480NCD	150-F480FCD	
				24V AC/DC♣	**150-F480NCR**	—	
	208...625	450	600	110/120V AC, 50/60 Hz	150-F625NCE	⌘	150-F625JCE
				230/240V AC, 50/60 Hz	150-F625NCA	⌘	150-F625JCA
	260...780	560	800	110/120V AC, 50/60 Hz	150-F780NCE	⌘	150-F780JCE
				230/240V AC, 50/60 Hz	150-F780NCA	⌘	150-F780JCA
	323...970	710	1000	110/120V AC, 50/60 Hz	150-F970NCE	—	
				230/240V AC, 50/60 Hz	150-F970NCA	—	
	416...1250	900	1300	110/120V AC, 50/60 Hz	150-F1250NCE	—	
				230/240V AC, 50/60 Hz	150-F1250NCA	—	

Rated Voltage [V AC]	Motor Current [A]❄	Max. kW, 50 Hz	Max. Hp, 60 Hz	Control Power	Open Type — Line-Connected Motors✶
					Cat. No.
690/Y‡	27...108	90	100	100...240V AC, 50/60 Hz	**150-F108NZD**
	34...135	132	175	100...240V AC, 50/60 Hz	**150-F135NZD**
	67...201	160	200	100...240V AC, 50/60 Hz	**150-F201NZD**
	84...251	200	250	100...240V AC, 50/60 Hz	**150-F251NZD**
	106...317	315	400	100...240V AC, 50/60 Hz	**150-F317NZD**
	120...361	355	450	100...240V AC, 50/60 Hz	**150-F361NZD**
	160...480	450	600	100...240V AC, 50/60 Hz	**150-F480NZD**
	208...625	630	800	110/120V AC, 50/60 Hz	150-F625NZE
				230/240V AC, 50/60 Hz	150-F625NZA
	260...780	800	1000	110/120V AC, 50/60 Hz	150-F780NZE
				230/240V AC, 50/60 Hz	150-F780NZA
	323...970	1000	1300	110/120V AC, 50/60 Hz	150-F970NZE
				230/240V AC, 50/60 Hz	150-F970NZA
	416...1250	1200	1600	110/120V AC, 50/60 Hz	150-F1250NZE
				230/240V AC, 50/60 Hz	150-F1250NZA

✶ Controllers rated 108 A and greater are not equipped with line and load terminal lugs. See page 4-126 for terminal lug kits.

❄ Motor FLA rating should fall within specified current range for unit to operate properly. Special consideration should be given when using a motor with a potentially high starting current (greater than ten times motor FLA) with the SMC Flex in the "Full Voltage" starting mode. Contact Rockwell Automation technical support for further guidance.

§ These controllers require a separate 100…240V, 50/60 Hz single-phase control source. To add a control circuit transformer to the enclosure, add the appropriate option code to the catalog string.

♣ Separate 120V or 240V single-phase power supply is required for fan operation.

➢ Line and load termination are provided as standard.

‡ To be used only in a Y-type system.

⌘ Available in IP54 (Type 12) enclosure only.

Open Type Controllers — For use with Delta-Connected Motors

Rated Voltage [V AC]	Motor Current [A]❄	Max. kW, 50 Hz	Max. Hp, 60 Hz	Control Power	Open Type✶ Cat. No.
200/208	1.7…8.7	—	2	100…240V AC, 50/60 Hz	**150-F5NBD**
				24V AC/DC♣	**150-F5NBR**
	8.7…43	—	10	100…240V AC, 50/60 Hz	**150-F25NBD**
				24V AC/DC♣	**150-F25NBR**
	14.9…74	—	20	100…240V AC, 50/60 Hz	**150-F43NBD**
				24V AC/DC♣	**150-F43NBR**
	20.8…104	—	30	100…240V AC, 50/60 Hz	**150-F60NBD**
				24V AC/DC♣	**150-F60NBR**
	29.4…147	—	40	100…240V AC, 50/60 Hz	**150-F85NBD**
				24V AC/DC♣	**150-F85NBR**
	47…187	—	60	100…240V AC, 50/60 Hz	**150-F108NBD**
				24V AC/DC♣	**150-F108NBR**
	59…234	—	75	100…240V AC, 50/60 Hz	**150-F135NBD**
				24V AC/DC♣	**150-F135NBR**
	116…348	—	100	100…240V AC, 50/60 Hz	**150-F201NBD**
				24V AC/DC♣	**150-F201NBR**
	145…435	—	150	100…240V AC, 50/60 Hz	**150-F251NBD**
				24V AC/DC♣	**150-F251NBR**
	183…549	—	200	100…240V AC, 50/60 Hz	**150-F317NBD**
				24V AC/DC♣	**150-F317NBR**
	208…625	—	200	100…240V AC, 50/60 Hz	**150-F361NBD**
				24V AC/DC♣	**150-F361NBR**
	277…831	—	300	100…240V AC, 50/60 Hz	**150-F480NBD**
				24V AC/DC♣	**150-F480NBR**
	283…850	—	300	110/120V AC, 50/60 Hz	**150-F625NBE**
				230/240V AC, 50/60 Hz	150-F625NBA
	300…900	—	300	110/120V AC, 50/60 Hz	150-F780NBE
				230/240V AC, 50/60 Hz	150-F780NBA
	400…1200	—	400	110/120V AC, 50/60 Hz	150-F970NBE
				230/240V AC, 50/60 Hz	150-F970NBA
	533…1600	—	500	110/120V AC, 50/60 Hz	150-F1250NBE
				230/240V AC, 50/60 Hz	150-F1250NBA

✶ Controllers rated 108 A and greater are not equipped with line and load terminal lugs. See page 4-126 for terminal lug kits.

❄ Motor FLA rating should fall within specified current range for unit to operate properly. Special consideration should be given when using a motor with a potentially high starting current (greater than ten times motor FLA) with the SMC Flex in the "Full Voltage" starting mode. Contact Rockwell Automation technical support for further guidance.

♣ Separate 120V or 240V single-phase power supply is required for fan operation.

Open Type Controllers — For use with Delta-Connected Motors, Continued

Rated Voltage [V AC]	Motor Current [A]❄	Max. kW, 50 Hz	Max. Hp, 60 Hz	Control Power	Open Type✶ Cat. No.
230	1.7…8.7	2.2	2	100…240V AC, 50/60 Hz	**150-F5NBD**
				24V AC/DC♣	**150-F5NBR**
	8.7…43	11	15	100…240V AC, 50/60 Hz	**150-F25NBD**
				24V AC/DC♣	**150-F25NBR**
	14.9…74	22	25	100…240V AC, 50/60 Hz	**150-F43NBD**
				24V AC/DC♣	**150-F43NBR**
	20.8…104	30	40	100…240V AC, 50/60 Hz	**150-F60NBD**
				24V AC/DC♣	**150-F60NBR**
	29.4…147	45	50	100…240V AC, 50/60 Hz	**150-F85NBD**
				24V AC/DC♣	**150-F85NBR**
	47…187	55	60	100…240V AC, 50/60 Hz	**150-F108NBD**
				24V AC/DC♣	**150-F108NBR**
	59…234	75	75	100…240V AC, 50/60 Hz	**150-F135NBD**
				24V AC/DC♣	**150-F135NBR**
	116…348	110	125	100…240V AC, 50/60 Hz	**150-F201NBD**
				24V AC/DC♣	**150-F201NBR**
	145…435	132	150	100…240V AC, 50/60 Hz	**150-F251NBD**
				24V AC/DC♣	**150-F251NBR**
	183…549	160	200	100…240V AC, 50/60 Hz	**150-F317NBD**
				24V AC/DC♣	**150-F317NBR**
	208…625	200	250	100…240V AC, 50/60 Hz	**150-F361NBD**
				24V AC/DC♣	**150-F361NBR**
	277…831	250	350	100…240V AC, 50/60 Hz	**150-F480NBD**
				24V AC/DC♣	**150-F480NBR**
	283…850	250	350	110/120V AC, 50/60 Hz	**150-F625NBE**
				230/240V AC, 50/60 Hz	150-F625NBA
	300…900	250	350	110/120V AC, 50/60 Hz	150-F780NBE
				230/240V AC, 50/60 Hz	150-F780NBA
	400…1200	400	400	110/120V AC, 50/60 Hz	150-F970NBE
				230/240V AC, 50/60 Hz	150-F970NBA
	533…1600	500	600	110/120V AC, 50/60 Hz	150-F1250NBE
				230/240V AC, 50/60 Hz	150-F1250NBA

✶ Controllers rated 108 A and greater are not equipped with line and load terminal lugs. See page 4-126 for terminal lug kits.

❄ Motor FLA rating should fall within specified current range for unit to operate properly. Special consideration should be given when using a motor with a potentially high starting current (greater than ten times motor FLA) with the SMC Flex in the "Full Voltage" starting mode. Contact Rockwell Automation technical support for further guidance.

♣ Separate 120V or 240V single-phase power supply is required for fan operation.

Open Type Controllers — For use with Delta-Connected Motors, Continued

Rated Voltage [V AC]	Motor Current [A]❄	Max. kW, 50 Hz	Max. Hp, 60 Hz	Control Power	Open Type✶ Cat. No.
400/415/460	1.7…8.7	4	5	100…240V AC, 50/60 Hz	**150-F5NBD**
				24V AC/DC♣	**150-F5NBR**
	8.7…43	22	30	100…240V AC, 50/60 Hz	**150-F25NBD**
				24V AC/DC♣	**150-F25NBR**
	14.9…74	37	50	100…240V AC, 50/60 Hz	**150-F43NBD**
				24V AC/DC♣	**150-F43NBR**
	20.8…104	55	75	100…240V AC, 50/60 Hz	**150-F60NBD**
				24V AC/DC♣	**150-F60NBR**
	29.4…147	75	100	100…240V AC, 50/60 Hz	**150-F85NBD**
				24V AC/DC♣	**150-F85NBR**
	47…187	90	150	100…240V AC, 50/60 Hz	**150-F108NBD**
				24V AC/DC♣	**150-F108NBR**
	59…234	132	150	100…240V AC, 50/60 Hz	**150-F135NBD**
				24V AC/DC♣	**150-F135NBR**
	116…348	160	250	100…240V AC, 50/60 Hz	**150-F201NBD**
				24V AC/DC♣	**150-F201NBR**
	145…435	250	350	100…240V AC, 50/60 Hz	**150-F251NBD**
				24V AC/DC♣	**150-F251NBR**
	183…549	315	450	100…240V AC, 50/60 Hz	**150-F317NBD**
				24V AC/DC♣	**150-F317NBR**
	208…625	355	500	100…240V AC, 50/60 Hz	**150-F361NBD**
				24V AC/DC♣	**150-F361NBR**
	277…831	450	700	100…240V AC, 50/60 Hz	**150-F480NBD**
				24V AC/DC♣	**150-F480NBR**
	283…850	500	700	110/120V AC, 50/60 Hz	**150-F625NBE**
				230/240V AC, 50/60 Hz	150-F625NBA
	300…900	500	700	110/120V AC, 50/60 Hz	150-F780NBE
				230/240V AC, 50/60 Hz	150-F780NBA
	400…1200	710	1000	110/120V AC, 50/60 Hz	150-F970NBE
				230/240V AC, 50/60 Hz	150-F970NBA
	533…1600	900	1400	110/120V AC, 50/60 Hz	150-F1250NBE
				230/240V AC, 50/60 Hz	150-F1250NBA

✶ Controllers rated 108 A and greater are not equipped with line and load terminal lugs. See page 4-126 for terminal lug kits.

❄ Motor FLA rating should fall within specified current range for unit to operate properly. Special consideration should be given when using a motor with a potentially high starting current (greater than ten times motor FLA) with the SMC Flex in the "Full Voltage" starting mode. Contact Rockwell Automation technical support for further guidance.

♣ Separate 120V or 240V single-phase power supply is required for fan operation.

Open Type Controllers — For use with Delta-Connected Motors, Continued

Rated Voltage [V AC]	Motor Current [A]❄	Max. kW, 50 Hz	Max. Hp, 60 Hz	Control Power	Open Type✶ Cat. No.
500/575	1.7…8.7	5.5	7.5	100…240V AC, 50/60 Hz	**150-F5NCD**
				24V AC/DC♣	**150-F5NCR**
	8.7…43	15	40	100…240V AC, 50/60 Hz	**150-F25NCD**
				24V AC/DC♣	150-F25NCR
	14.9…74	45	60	100…240V AC, 50/60 Hz	**150-F43NCD**
				24V AC/DC♣	**150-F43NCR**
	20.8…104	55	100	100…240V AC, 50/60 Hz	**150-F60NCD**
				24V AC/DC♣	**150-F60NCR**
	29.4…147	90	150	100…240V AC, 50/60 Hz	**150-F85NCD**
				24V AC/DC♣	**150-F85NCR**
	47…187	132	150	100…240V AC, 50/60 Hz	150-F108NCD
				24V AC/DC♣	**150-F108NCR**
	59…234	160	200	100…240V AC, 50/60 Hz	**150-F135NCD**
				24V AC/DC♣	**150-F135NCR**
	116…348	250	300	100…240V AC, 50/60 Hz	**150-F201NCD**
				24V AC/DC♣	**150-F201NCR**
	145…435	315	400	100…240V AC, 50/60 Hz	**150-F251NCD**
				24V AC/DC♣	**150-F251NCR**
	183…549	400	500	100…240V AC, 50/60 Hz	**150-F317NCD**
				24V AC/DC♣	**150-F317NCR**
	208…625	450	600	100…240V AC, 50/60 Hz	**150-F361NCD**
				24V AC/DC♣	**150-F361NCR**
	277…831	560	900	100…240V AC, 50/60 Hz	150-F480NCD
				24V AC/DC♣	**150-F480NCR**
	283…850	560	900	110/120V AC, 50/60 Hz	150-F625NCE
				230/240V AC, 50/60 Hz	150-F625NCA
	300…900	630	900	110/120V AC, 50/60 Hz	150-F780NCE
				230/240V AC, 50/60 Hz	150-F780NCA
	400…1200	800	1300	110/120V AC, 50/60 Hz	150-F970NCE
				230/240V AC, 50/60 Hz	150-F970NCA
	533…1600	1100	1600	110/120V AC, 50/60 Hz	150-F1250NCE
				230/240V AC, 50/60 Hz	150-F1250NCA

✶ Controllers rated 108 A and greater are not equipped with line and load terminal lugs. See page 4-126 for terminal lug kits.

❄ Motor FLA rating should fall within specified current range for unit to operate properly. Special consideration should be given when using a motor with a potentially high starting current (greater than ten times motor FLA) with the SMC Flex in the "Full Voltage" starting mode. Contact Rockwell Automation technical support for further guidance.

♣ Separate 120V or 240V single-phase power supply is required for fan operation.

Combination Line-Connected Controllers — IP65 (Type 4/12) Enclosed with Fusible Disconnect or Circuit Breaker

Rated Voltage [V AC]	kW, 50 Hz	Hp, 60 Hz	Controller Current Rating [A] ❄	IP65 (Type 4/12) Enclosed Combination Controllers with Fusible Disconnect✶	IP65 (Type 4/12) Enclosed Combination Controllers with Circuit Breaker✶
				Cat. No.§	Cat. No.
200	—	0.5	5	152H-F5FHD-33	153H-F5FHD-33
	—	0.75	5	152H-F5FHD-34	153H-F5FHD-34
	—	1	5	152H-F5FHD-35	153H-F5FHD-35
	—	1.5	25	152H-F25FHD-36	153H-F25FHD-36
	—	2	25	152H-F25FHD-37	153H-F25FHD-37
	—	3	25	152H-F25FHD-38	153H-F25FHD-38
	—	5	25	152H-F25FHD-39	153H-F25FHD-39
	—	5	25	152H-F25FHD-40	153H-F25FHD-40
	—	10	43	152H-F43FHD-41	153H-F43FHD-41
	—	15	60	152H-F60FHD-42	153H-F60FHD-42
	—	20	85	152H-F85FHD-43	153H-F85FHD-43
	—	25	85	152H-F85FHD-44	153H-F85FHD-44
	—	30	108	152H-F108FHD-45	153H-F108FHD-45
	—	40	135	152H-F135FHD-46	153H-F135FHD-46
	—	50	201	152H-F201FHD-47	153H-F201FHD-47
	—	60	201	152H-F201FHD-48	153H-F201FHD-48
	—	75	251	152H-F251FHD-49	153H-F251FHD-49
	—	100	317	152H-F317FHD-50	153H-F317FHD-50
	—	125	361	152H-F361FHD-51	153H-F361FHD-51
	—	150	480	152H-F480FHD-52	153H-F480FHD-52
	—	200	625	♣ 152H-F625JHD-54	♣ 153H-F625JHD-54
	—	250	780	♣ 152H-F780JHD-56	♣ 153H-F780JHD-56
230	0.37	0.5	5	152H-F5FAD-33	153H-F5FAD-33
	0.55	0.75	5	152H-F5FAD-34	153H-F5FAD-34
	0.75	1	5	152H-F5FAD-35	153H-F5FAD-35
	1.1	1.5	25	152H-F25FAD-36	153H-F25FAD-36
	1.5	2	25	152H-F25FAD-37	153H-F25FAD-37
	2.2	3	25	152H-F25FAD-38	153H-F25FAD-38
	3.7	5	25	152H-F25FAD-39	153H-F25FAD-39
	5.5	7.5	25	152H-F25FAD-40	153H-F25FAD-40
	7.5	10	43	152H-F43FAD-41	153H-F43FAD-41
	11	15	43	152H-F43FAD-42	153H-F43FAD-42
	15	20	60	152H-F60FAD-43	153H-F60FAD-43
	18.5	25	85	152H-F85FAD-44	153H-F85FAD-44
	22	30	85	152H-F85FAD-45	153H-F85FAD-45
	30	40	108	152H-F108FAD-46	153H-F108FAD-46
	37	50	135	152H-F135FAD-47	153H-F135FAD-47
	45	60	201	152H-F201FAD-48	153H-F201FAD-48
	55	75	201	152H-F201FAD-49	153H-F201FAD-49
	75	100	251	152H-F251FAD-50	153H-F251FAD-50
	90	125	317	152H-F317FAD-51	153H-F317FAD-51
	110	150	361	152H-F361FAD-52	153H-F361FAD-52
	132	200	480	♣ 152H-F480JAD-54	153H-F480FAD-54
	185	250	625	♣ 152H-F625JAD-56	♣ 153H-F625JAD-56
	220	300	780	♣ 152H-F780JAD-57	♣ 153H-F780JAD-57

✶ These controllers require a separate 100…240V, 50/60 Hz single-phase control source. To add a control circuit transformer to the enclosure, add the appropriate option code to the catalog string.

❄ The nominal current rating for the combination package may differ from the controller, based on the horsepower. Consult your local Rockwell Automation sales office or Allen-Bradley distributor.

§ Provided with Class J or L fuse clips as standard.

♣ Available in IP54 (Type 12) enclosure only.

Combination Line-Connected Controllers — IP65 (Type 4/12) Enclosed with Fusible Disconnect or Circuit Breaker, Cont.

These controllers include line and load terminations. Enclosures other than those listed are available; consult your local Rockwell Automation sales office or Allen-Bradley distributor. All Bulletin 153 catalog numbers are supplied with thermal magnetic circuit breakers.

The fusible disconnects do not come with fuses.

Rated Voltage [V AC]	kW, 50 Hz	Hp, 60 Hz	Controller Current Rating [A] ❄	IP65 (Type 4/12) Enclosed Combination Controllers with Fusible Disconnect✶ Cat. No.§	IP65 (Type 4/12) Enclosed Combination Controllers with Circuit Breaker✶ Cat. No.
400/460	0.37	0.5	5	152H-F5FBD-33	153H-F5FBD-33
	0.55	0.75	5	152H-F5FBD-34	153H-F5FBD-34
	0.75	1	5	152H-F5FBD-35	153H-F5FBD-35
	1.1	1.5	5	152H-F5FBD-36	153H-F5FBD-36
	1.5	2	5	152H-F5FBD-37	153H-F5FBD-37
	2.2	3	5	152H-F5FBD-38	153H-F5FBD-38
	3.7	5	25	152H-F25FBD-39	153H-F25FBD-39
	5.5	7.5	25	152H-F25FBD-40	153H-F25FBD-40
	7.5	10	25	152H-F25FBD-41	153H-F25FBD-41
	11	15	25	152H-F25FBD-42	153H-F25FBD-42
	15	20	43	152H-F43FBD-43	153H-F25FBD-43
	18.5	25	43	152H-F43FBD-44	153H-F43FBD-44
	22	30	43	152H-F43FBD-45	153H-F43FBD-45
	30	40	60	152H-F60FBD-46	153H-F60FBD-46
	37	50	85	152H-F85FBD-47	153H-F85FBD-47
	45	60	85	152H-F85FBD-48	153H-F85FBD-48
	55	75	108	152H-F108FBD-49	153H-F108FBD-49
	75	100	135	152H-F135FBD-50	153H-F135FBD-50
	90	125	201	152H-F201FBD-51	153H-F201FBD-51
	110	150	201	152H-F201FBD-52	153H-F201FBD-52
	132	200	251	152H-F251FBD-54	153H-F251FBD-54
	160	250	317	152H-F317FBD-56	153H-F317FBD-56
	200	300	361	152H-F361FBD-57	153H-F361FBD-57
	250	350	480	152H-F480FBD-58	153H-F480FBD-58
	250	400	480	♣ 152H-F480JBD-59	153H-F480FBD-59
	355	500	625	♣ 152H-F625JBD-61	♣ 153H-F625JBD-61
	450	600	780	♣ 152H-F780JBD-62	♣ 153H-F780JBD-62
500/575	0.55	0.75	5	152H-F5FCD-34	153H-F5FCD-34
	0.75	1	5	152H-F5FCD-35	153H-F5FCD-35
	1.1	1.5	5	152H-F5FCD-36	153H-F5FCD-36
	1.5	2	5	152H-F5FCD-37	153H-F5FCD-37
	2.2	3	5	152H-F5FCD-38	153H-F5FCD-38
	3.7	5	25	152H-F25FCD-39	153H-F25FCD-39
	5.5	7.5	25	152H-F25FCD-40	153H-F25FCD-40
	7.5	10	25	152H-F25FCD-41	153H-F25FCD-41
	11	15	25	152H-F25FCD-42	153H-F25FCD-42
	15	20	43	152H-F43FCD-43	153H-F43FCD-43
	18.5	25	43	152H-F43FCD-44	153H-F43FCD-44
	22	30	43	152H-F43FCD-45	153H-F43FCD-45
	22	40	43	152H-F43FCD-46	153H-F43FCD-46
	37	50	60	152H-F60FCD-47	153H-F60FCD-47
	45	60	85	152H-F85FCD-48	153H-F85FCD-48
	55	75	85	152H-F85FCD-49	153H-F85FCD-49
	75	100	108	152H-F108FCD-50	153H-F108FCD-50
	90	125	135	152H-F135FCD-51	153H-F135FCD-51
	110	150	201	152H-F201FCD-52	153H-F201FCD-52
	132	200	201	152H-F201FCD-54	153H-F201FCD-54
	160	250	251	152H-F251FCD-56	153H-F251FCD-56
	200	300	317	152H-F317FCD-57	153H-F317FCD-57
	250	350	361	152H-F361FCD-58	153H-F361FCD-58
	295	400	480	♣ 152H-F480JCD-59	153H-F480FCD-59
	315	450	480	♣ 152H-F480JCD-60	153H-F480FCD-60
	315	500	480	♣ 152H-F480JCD-61	153H-F480FCD-61
	450	600	625	♣ 152H-F625JCD-62	♣ 153H-F625JCD-62
	560	800	780	♣ 152H-F780JCD-65	♣ 153H-F780JCD-65

✶ These controllers require a separate 100…240V, 50/60 Hz single-phase control source. To add a control circuit transformer to the enclosure, add the appropriate option code to the catalog string.

❄ The nominal current rating for the combination package may differ from the controller, based on the horsepower. Consult your local Rockwell Automation sales office or Allen-Bradley distributor.

§ Provided with Class J or L fuse clips as standard.

♣ Available in IP54 (Type 12) enclosure only.

Control Options (open and enclosed)

Option	Description	Cat. No. Modification
Pump Control	Provides smooth motor acceleration and deceleration, reducing surges caused by the starting and stopping of centrifugal pumps. Starting time is adjustable from 0…30 s, and stopping time is adjustable from 0…120 s.	B✶
Braking Control	Provides Smart Motor Braking (SMB), Accu-Stop, and Slow Speed with Braking.	D✶

Enclosed Options

Option	Description	Cat. No. Modification
Push Buttons	Start-Stop Push Button	-1
	Start-Stop Push Button with H-O-A Selector Switch	-1F
	Soft Stop Push Button❄	1XA
	Pump Stop Push Button❄	1XB
	Slow Speed Push Button❄	1XC
	Brake Push Button❄	1XD
	Accu-Stop/Slow Speed Push Button❄	1XE
Selector Switch	Hand-Off-Auto Selector Switch	-3
	SMC-Off-Bypass Selector Switch	-3B ✦
Pilot Lights	Transformer Pilot Light - Green Power On Indicator	-4G
	Transformer Pilot Light - Red Run Indicator	-4R
	Push-to-Test Pilot Light - Red Run Indicator	-5R
Control Circuit Transformer	Control Circuit Transformer (fused primary and secondary)	-6P
	Additional 100VA Control Circuit Transformer (fused primary and secondary)	-6PX
	1000VA Control Circuit Transformer (fused primary and secondary)	-6PK
	1600VA Control Circuit Transformer (fused primary and secondary)	-6PL
	2000VA Control Circuit Transformer (fused primary and secondary)	-6PM
Protective Modules	480V Line Side Protective Module	-8L
	600V Line Side Protective Module	
	480V Load Side Protective Module	-8M
	600V Load Side Protective Module	
	480V Both Line and Load Side Protective Modules	-8B
	600V Both Line and Load Side Protective Modules	
Human Interface Module	Door-mounted, Full Numeric (Type 4/12)	-HC3
Communication Module	RS-485	-20S
	DeviceNet	-20D
	Ethernet/IP	-20E
	Control Net	-20C
	ProfiBUS	-20P
Disconnect Auxiliary	N.O. disconnect auxiliary mounted on operating mechanism	-98
	N.C. disconnect auxiliary mounted on operating mechanism	-99
Circuit Breaker Auxiliary	Internal N.O. circuit breaker auxiliary	-98X
	Internal N.C. circuit breaker auxiliary	-99X
Service Entrance Label	Service Entrance Label	-SEL
Oil Pump Starter	Bulletin 509 NEMA Size 1starter and Bulletin 592 solid-state overload	-OPS

✶ Add the designated letter to the end of the cat. no. Example: To add the Pump Control option: **Cat. No. 150-F361NBDB** or **Cat. No. 152H-F361FBDB-57**.
❄ Option push buttons are available only when the corresponding option module is selected. Example: **Cat. No. 150-F108FBDB-1XB**.
✦ Bypass contactor and overload are not included with this option. A **-NB** or **-BP** needs to be added to the catalog string to add these devices.

Enclosed Options, Continued

Option	Description	Cat. No. Modification
NEMA Bypass Contactor and Overload Relay	5…43 A	-NB
	60…85 A	
	108…135 A	
	201…251 A	
	317…361 A	
	480 A	
NEMA Isolation Contactor	5…43 A	-NI
	60…85 A	
	108…135 A	
	201…251 A	
	317…361 A	
	480 A	
MCS Bypass Contactor and Overload Relay	5…43 A	-BP
	60…85 A	
	108…135 A	
	201…251 A	
	317…361 A	
	480 A	

Accessories

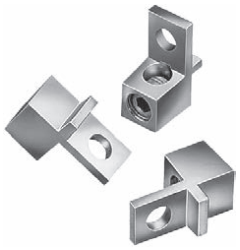
Protective Modules∗

Protective modules must not be placed on the load side of a device when using an inside-the-delta connection or with Pump, Braking, or Linerar Speed control.

Current Rating [A]	Description	Field Modification Cat. No.
5…85	480V Protective Module	**150-F84**
108…1250		**150-F84L**
5…85	600V Protective Module	**150-F86**
108…1250		150-F86L

∗ The same protective module mounts on the line or load side of the SMC Flex. For applications requiring both line and load side protection, two protective modules must be ordered.

Terminal Lug Kits (108…1250 A)



Current Rating [A] ❄	Wire Size	Total No. of Line Controller Terminal Lugs Possible Each Side		Pkg. Qty.	Cat. No.
		Line Side	Load Side		
108…135♣	#6…250 MCM AWG 16 mm²…120 mm²	3	3	3	**199-LF1**
201…251♣		6	6		
317…480♣	#4…500 MCM AWG 25 mm²…240 mm²	6	6		**199-LG1**
625…780	2/0…500 MCM AWG	6	6		**100-DL630**
970	4/0…500 MCM AWG	3	3		100-DL860
1250§	2/0…500 MCM AWG	3	3		**100-DL630**
	4/0…500 MCM AWG	3	3		100-DL860

Line and Load terminals are provided as standard on enclosed SMCs.

❄ 5…85 A units have box lugs standard. No additional lugs are required.

§ The 1250 A device requires (1) 100-DL630 and (1) 100-DL860 per connection.

♣ When a multi-conductor lug is required, refer to the User Manual for appropriate lug catalog number.

IEC Terminal Covers

Description‡	Package Quantity	Field Modification Cat. No.
IEC line or load terminal covers for 108 and 135 A devices. Dead front protection	1	**150-TC1**
IEC line or load terminal covers for 201…251 A devices. Dead front protection	1	**150-TC2**
IEC line or load terminal covers for 317…480 A devices. Dead front protection	1	**150-TC3**

‡ 5…85 A units have terminal guards standard. No additional terminal guards are required.

Human Interface and Communication Modules

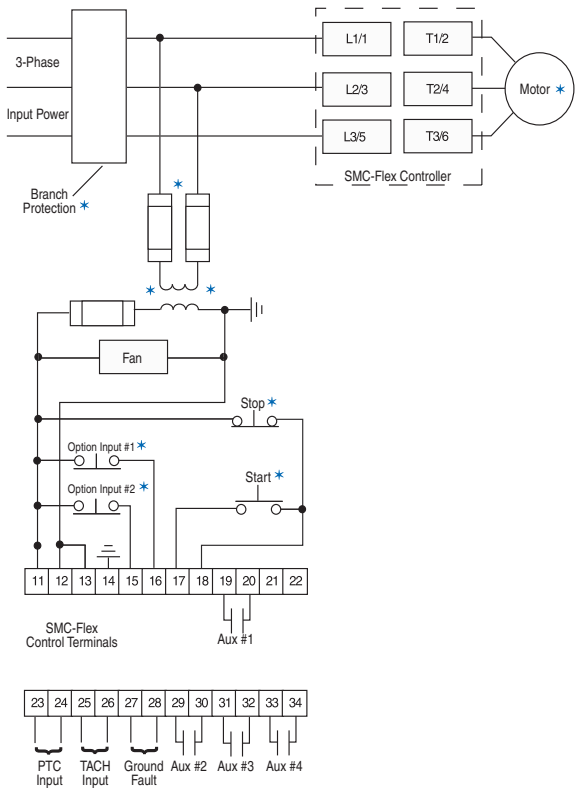
		Description		Cat. No.
	Hand-Held Human Interface Modules	LCD Display, Full Numeric Keypad∗		**20-HIM-A3**
		LCD Display, Programmer Only∗		20-HIM-A5
	Door-Mounted Human Interface Modules	Remote (Panel Mount) LCD Display, Full Numeric Keypad		**20-HIM-C3S**
		LCD Display, Programmer Only HIM (includes 3 m cable)		**20-HIM-C5S**
	Human Interface Module Interface Cables	PowerFlex HIM Interface Cable, 1 m (39 in)		20-HIM-H10
		Cable Kit (Male-Female) 0.33 m (1.1 ft)		1202-H03
		Cable Kit (Male-Female) 1 m (3.3 ft)		**1202-H10**
		Cable Kit (Male-Female) 3 m (9.8 ft)		**1202-H30**
		Cable Kit (Male-Female) 9 m (29.5 ft)		**1202-H90**
		DPI/SCANport™ One to Two Port Splitter Cable		**1203-S03**
		Description (IP30/Type 1)	**For Use With**	
	Communication Modules	RS485 DF1 Communication Adapter	Bulletin 150 SMC-Flex	20-COMM-S
		PROFIBUS™ DP Communication Adapter		**20-COMM-P**
		ControlNet™ Communication Adapter (Coax)		20-COMM-C
		Interbus™ Communication Adapter		20-COMM-I
		Modbus/TCP Communication Adapter		**20-COMM-M**
		DeviceNet™ Communication Adapter		**20-COMM-D**
		EtherNet/IP™ Communication Adapter		20-COMM-E
		HVAC Communication Adapter		20-COMM-H
		ControlNet™ Communication Adapter (Fiber)		20-COMM-Q
	DriveTools™	Programming Software	WIN NT/2000/XP	**9303-4DTE01ENE**
	DriveTools™ Sp	Programming Software	WIN NT/2000/XP	**9303-4DTS01ENE**
	AnaCANda™ RS-232 to DPI	PC Interface	Serial	**1203-SSS**
	DPI to USB	PC Interface	USB	**1203-USB**

∗ Requires a 20-HIM-H10 cable to connect to the SMC Flex.

4

Functional Design Specifications			
Standard Features	Installation	Power Wiring	Standard squirrel-cage induction motor or a Wye-Delta, six-lead motor.
		Control Wiring	2- and 3-wire control for a wide variety of applications.
	Setup	Keypad	Front keypad and backlit LCD display.
		Software	Parameter values can be downloaded to the SMC-Flex Controller with DriveTools programming software and the Cat. No. 20-COMM… DPI communication module.
	Communications		One DPI provided for connection to optional human interface and communication modules.
	Starting and Stopping Modes		Soft Start Current Limit Start Dual Ramp Full Voltage Linear Speed Acceleration Preset Slow Speed Soft Stop
	Protection and Diagnostics		Power loss, line fault, voltage unbalance, excessive starts/hour, phase reversal, undervoltage, overvoltage, controller temp, stall, jam, open gate, overload, underload, communication fault.
	Metering		Amps, volts, kW, kWH, MW, MWH, elapsed time, power factor, motor thermal capacity usage.
	Alarm Contact		Overload, underload, undervoltage, overvoltage, unbalance, jam, stall, and ground fault
	Status Indication		Stopped, starting, stopping, at speed, alarm, and fault.
	Auxiliary Contacts		Four fully programmable contacts as normal/up-to-speed/fault/alarm/network (N.O./N.C.), or external bypass (N.O. only).
Optional Features	Pump Control		Helps reduce fluid surges in centrifugal pumping systems during starting and stopping period. Starting time is adjustable from 0…30 s. Stopping time is adjustable from 0…120 s.
	Braking Control	SMB Smart Motor Braking	Provides motor braking without additional equipment for applications that require the motor to stop quickly. Braking current is adjustable from 0…400% of the motor's full-load current rating.
		Accu-Stop	Provides controlled position stopping. During stopping, braking torque is applied to the motor until it reaches preset slow speed (7% or 15% of rated speed) and holds the motor at this speed until a stop command is given. Braking torque is then applied until the motor reaches zero speed. Braking current is programmable from 0…450% of full-load current.
		Slow Speed with Braking	Used on applications that require slow speed (in the forward direction) for positioning or alignment and also require braking control to stop.

Wiring Diagram — Line Controller



* Customer supplied.

Electrical Ratings				
		Device Rating	UL/CSA/NEMA	IEC
Power Circuit	Rated Operation Voltage	480V	200…480V AC (–15%, +10%)	200…415V
		600V	200…600V AC (–15%, +10%)	200…500V
		690V	230…600V AC (–15%, +10%)	230…690V/Y (–15%, +10%)
	Rated Insulation Voltage	480V	N/A	500V
		600V		500V
		690V		690V
	Rated Impulse Voltage	480V	N/A	6000V
		600V		
		690V		
	Dielectric Withstand	480V	2200V AC	2500V
		600V		
		690V		
	Repetitive Peak Inverse Voltage Rating	480V	1400V	1400V
		600V	1600V	1600V
		690V	1800V	1800V
	Operating Frequency	All	50/60 Hz	
	Utilization Category	5…480 A	MG 1	AC-53B:3.0-50:1750
		625…1250 A	MG 1	AC-53B:3.0-50:3550
	Protection Against Electrical Shock	5…85 A	N/A	IP20
		108…480 A		IP2X (with terminal covers)
		625…1250 A		IP00 (open device)
	DV/DT Protection	480V & 600V	RC Snubber Network	
		690V	None	
	Transient Protection	480V & 600V	Metal Oxide Varistors: 220 Joules	
		690V	None	
Control Circuit	Rated Operational Voltage§	5…480 A	100…240V AC or 24V AC/DC	
		625…1250 A	110/120V AC and 230/240V AC	
	Rated Insulation Voltage	All	N/A	240V
	Rated Impulse Voltage	All	N/A	3000V
	Dielectric Withstand	All	1600V AC	2000V
	Operating Frequency	All	50/60 Hz	
	Input onstate voltage minimum		85V AC, 19.2V DC / 20.4V AC	
	Input onstate current		20 mA @120V AC / 40 mA @ 240V AC, 7.6 mA @ 24V AC/DC	
	Input offstate voltage maximum		50V AC, 10V DC / 12V AC	
	Input offstate current @ input offstate voltage		<10 mA AC, <3 mA DC	

§ 690V power is only available with 100…240V control.

Electrical Ratings								
Short-Circuit Protection	SCPD Performance 200…600V		Type 1§♣					
	SCCR List✶		Max. Standard Available Fault	Max. Standard Fuse [A]❄	Max. Standard Available Fault	Max. Circuit Breaker [A]	Max. High Fault	Max. Fuse [A] ‡
	Line Device Operational Current Rating [A]	5	5 kA	20	5 kA	20	70 kA	10
		25	5 kA	100	5 kA	100	70 kA	50
		43	10 kA	150	10 kA	150	70 kA	90
		60	10 kA	225	10 kA	225	70 kA	125
		85	10 kA	300	10 kA	300	70 kA	175
		108	10 kA	400	10 kA	300	70 kA	200
		135	10 kA	500	10 kA	400	70 kA	225
		201	18 kA	600	18 kA	600	70 kA	350
		251	18 kA	700	18 kA	700	70 kA	400
		317	30 kA	800	30 kA	800	69 kA	500
		361	30 kA	1000	30 kA	1000	69 kA	600
		480	42 kA	1200	42 kA	1200	69 kA	800
		625	42 kA	1600	42 kA	1600	74 kA	1600
		780	42 kA	1600	42 kA	2000	74 kA	1600
		970	85 kA	2500	85 kA	2500	85 kA	2500
		1250	85 kA	3000	85 kA	3200	85 kA	3000
	Delta Device Operational Current Rating [A]	8.7	5 kA	35	5 kA	35	70 kA	17.5
		43	5 kA	150	5 kA	150	70 kA	90
		74	10 kA	300	10 kA	300	70 kA	150
		104	10 kA	400	10 kA	400	70 kA	200
		147	10 kA	400	10 kA	400	70 kA	200
		187	10 kA	600	10 kA	500	70 kA	300
		234	10 kA	700	10 kA	700	70 kA	400
		348	18 kA	1000	18 kA	1000	70 kA	600
		435	18 kA	1200	18 kA	1200	70 kA	800
		549	30 kA	1600	30 kA	1600	69 kA	1000
		625	30 kA	1600	30 kA	1600	69 kA	1200
		831	42 kA	1600	30 kA	1600	69 kA	1600
		850	42 kA	1600	42 kA	2000	74 kA	1600
		900	42 kA	1600	42 kA	2000	74 kA	1600
		1200	85 kA	3000	85 kA	3200	85 kA	3000
		1600	85 kA	3000	85 kA	3200	85 kA	3000
	SCPD Performance 690V		Type 1§					
	SCCR List✶	Device Rating	Max. Standard Available Fault		Max. Ampere Tested — North American Style		Max. Ampere Tested — European Style	
	Maximum FLC	108	70 kA		A070URD33xxx500		6,9 gRB 73xxx400 6,6URD33xxx500	
		135	70 kA		A070URD33xxx500		6,9 gRB 73xxx400 6,6URD33xxx500	
		201	70 kA		A070URD33xxx700		6,9 gRB 73xxx630 6,6URD33xxx700	
		251	70 kA		A070URD33xxx700		6,9 gRB 73xxx630 6,6URD33xxx700	
		317	70 kA		A070URD33xxx900		6,9 gRB 73xxx800 6,6URD33xxx900	
		361	70 kA		A070URD33xxx900		6,9 gRB 73xxx800 6,6URD33xxx900	
		480	70 kA		A070D33xxx1250 A100URD73xxx1250		9 URD 73xxx1250 6,6URD33xxx1250	
		625	70 kA		A070URD33xxx1400		6,6URD33xxx1400	
		780	70 kA		A070URD33xxx1400		6,6URD33xxx1400	
		970	85 kA		Two fuses in parallel A070URD33xxx1250		Two fuses in parallel 6,6URD33xxx1250	
		1250	85 kA		Two fuses in parallel A070URD33xxx1250		Two fuses in parallel 6,6URD33xxx1250	

✶ Consult local codes for proper sizing of short circuit protection.

❄ Non-time delay fuses (K5 — 5…480V (8.7…831 A) devices; Class L — 625…1250V (850…1600 A) devices).

‡ High capacity fault rating when used with time delay class CC, J, or L fuses.

§ Type 1 performance/protection indicates that, under a short-circuit condition, the fused or circuit breaker-protected starter shall cause no danger to persons or installation but may not be suitable for further service without repair or replacement.

♣ For short-circuit current rating (SCCR) for enclosed panel with external bypass or isolation contactor, see the Industrial Controls catalog website: www.ab.com/catalogs.

Electrical Ratings					
Power Requirements	Control Module	1…480 A	120…240V AC	Transformer	75 VA
			24V AC	Transformer	130 VA
			24V DC	Inrush Current	5 A
				Inrush Time	250 ms
				Transient Watts	60 W
				Transient Time	500 ms
				Steady State Watts	24 W
				Minimum Allen-Bradley Power Supply	1606-XLP50E
		625…1250 A	751 VA (recommended 800 VA)		
	Heatsink Fan(s)♣		5…135 A, 20 VA		
			201…251 A, 40 VA		
			317…480 A, 60 VA		
			625…1250 A, 150 VA		
Steady State Heat Dissipation with Control and Fan Power (Watts)	Controller Rating [A]	5	70		
		25	70		
		43	81		
		60	97		
		85	129		
		108	91		
		135	104		
		201	180		
		251	198		
		317	225		
		361	245		
		480	290		
		625	446		
		780	590		
		970	812		
		1250	1222		
Auxiliary Contacts 19/20 (Aux #1) 29/30 (Aux #2) 31/32 (Aux #3) 33/34 (Aux #4)	Type of Control Circuit		Electromagnetic relay		
	Number of Contacts		1		
	Type of Contacts		programmable N.O./N.C.		
	Type of Current		AC		
	Rated Operational Current		3 A @ 120V AC, 1.5 A @ 240V AC		
	Conventional Thermal Current I_{th} AC/DC		5 A		
	Make/Break VA		3600/360		
	Utilization Category		AC-15/DC		
PTC Input Ratings	Response Resistance		3400 Ω ±150 Ω		
	Reset Resistance		1600 Ω ±100 Ω		
	Short-Circuit Trip Resistance		25 Ω ±10 Ω		
	Max. Voltage at PTC Terminals (R_{PTC} = 4 kΩ)		< 7.5V		
	Max. Voltage at PTC Terminals (R_{PTC} = open)		30V		
	Max. No. of Sensors.		6		
	Max. Cold Resistance of PTC Sensor Chain		1500 Ω		
	Response Time		800 ms		
Tach Input			0…5V DC, 4.5V DC = 100% Speed		

♣ Heatsink fans can be powered by either 110/120V AC or 220/240V AC.

Environmental	
Operating Temperature Range	-5…+50 °C (23…+122 °F) (open) -5…+40 °C (23…+104 °F) (enclosed)
Storage and Transportation Temperature Range	-20…+75 °C (-4…167 °F)
Altitude	2000 m (6560 ft)
Humidity	5…95% (non-condensing)
Pollution Degree	2

Mechanical			
Resistance to Vibration	Operational	All	1.0 G Peak, 0.15 mm (0.006 in.) displacement
	Non-Operational	5…480 A	2.5 G Peak, 0.38 mm (0.015 in.) displacement
		625…1250 A	1.0 G Peak, 0.15 mm (0.006 in.) displacement
Resistance to Shock	Operational	5…85 A	15 G
		108…480 A	5.5 G
		625…1250 A	4 G
	Non-Operational	5…85 A	30 G
		108…480 A	25 G
		625…1250 A	12 G
Construction	Power Poles	5…85 A	Heatsink thyristor modular design
	Power Poles	108…1250 A	Heatsink hockey puck thyristor modular design
	Control Modules		Thermoset and Thermoplastic Moldings
	Metal Parts		Plated Brass, Copper, or Painted Steel
Terminals	Power Terminals	5…85 A	Cable size — Line Upper — 2.5…95 mm² (14…3/0 AWG) Line Lower — 0.8…2.5 mm² (18…14 AWG) Load Upper — 2.5…50 mm² (14…1 AWG) Load Lower — 0.8…2.5 mm² (18…14 AWG) Tightening torque — 14.7 N•m (130 lb.-in.) Wire strip length — 18…20 mm (0.22…0.34 in.)
		108…135 A	One M10 x 1.5 diameter hole per power pole
		201…251 A	Two M10 x 1.5 diameter holes per power pole
		317…480 A	Two M12 x 1.75 diameter holes per power pole
		625…1250 A	Two 13.5 mm (0.53 in.) diameter holes per power pole
	Power Terminal Markings		NEMA, CENELEC EN50 012
	Control Terminals	M3 screw clamp	Clamping yoke connection

Other				
EMC Emission Levels	Conducted Radio Frequency Emissions Radiated Emissions		Class A Class A	
EMC Immunity Levels	Electrostatic Discharge Radio Frequency Electromagnetic Field Fast Transient Surge Transient		8 kV Air Discharge Per EN/IEC 60947-4-2 Per EN/IEC 60947-4-2 Per EN/IEC 60947-4-2	
Overload Characteristics	Current Range [A]		Line	Delta
		5	1...5	1.7…9
		25	5...25	8.6…43
		43	8.6...43	14.8…75
		60	12...60	20.8…104
		85	17...85	29.4…147
		108	27…108	47…187
		135	34…135	59…234
		201	67…201	116…348
		251	84…251	145…435
		317	106…317	183…549
		361	120…361	208…625
		480	160…480	277…831
		625	208…625	283…850
		780	260…780	300…900
		970	323…970	400…1200
		1250	416…1250	533…1600
	Trip Classes Trip Current Rating Number of Poles		10, 15, 20, and 30 117% of Motor FLC 3	
Certifications	Open-Type Controllers		CE Marked Per Low Voltage Directive 73/23/EEC, 93/68/EEC UL Listed (File No. E96956)	

Dimensions are in millimeters (inches). Dimensions are not intended for manufacturing purposes.

Approximate Dimensions and Shipping Weights

Open Type Controllers

Rating [A]	Height	Width	Depth	Weight
5…85	321 (12.6)	150 (5.9)	203 (8.0)	5.7 kg (12.6 lbs)
108…135	443.7 (17.47)	196.4 (7.74)	205.2 (8.08)	15.0 kg (33 lbs).
201…251	560 (22.05)	225 (8.86)	253.8 (9.99)	30.4 kg (67 lbs).
317…480	600 (23.62)	290 (11.42)	276.5 (10.89)	45.8 kg (101 lbs)
625…780	1041.1 (41.0)	596.9 (23.5)	346.2 (13.63)	179 kg (395 lbs)
970…1250	1041.1 (41.0)	596.9 (23.5)	346.2 (13.63)	224 kg (495 lbs)

Enclosed-Type Line-Connected Controllers

Factory-installed options may affect enclosure size requirements.
Exact dimensions can be obtained after order entry. Please consult your local Rockwell Automation sales office or Allen-Bradley distributor.

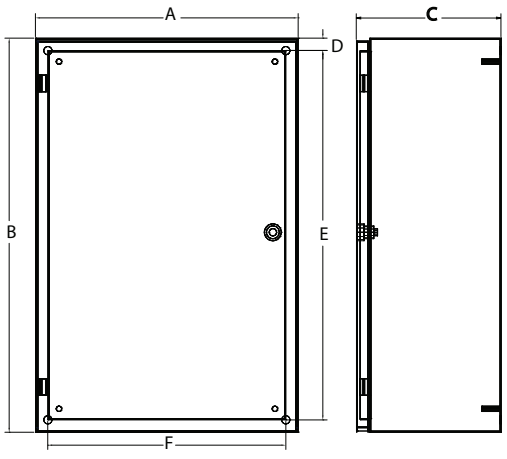


Figure 1 — Wall-Mount

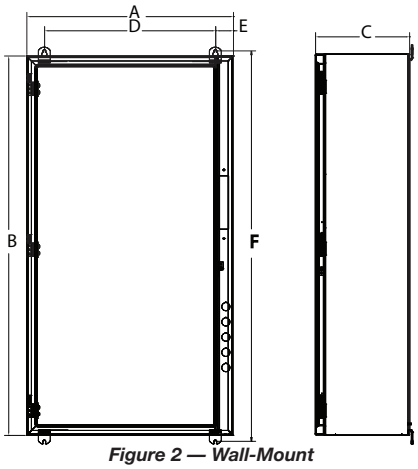


Figure 2 — Wall-Mount

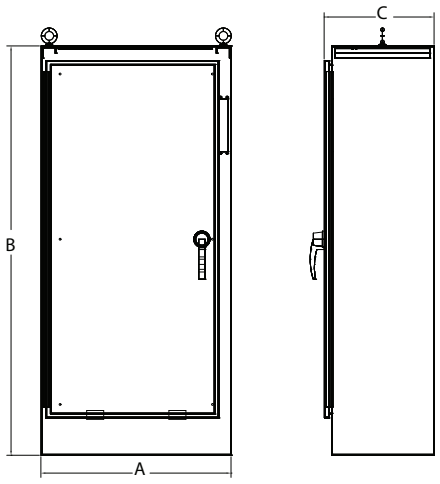


Figure 3 — Floor-Mount

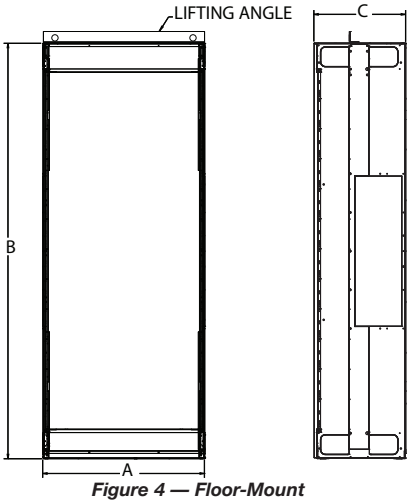


Figure 4 — Floor-Mount

Controller Rating [A]	Bulletin	With Option	Dimension Figure No.	Dimensions in inches (mm)					
				A (Width)	B (Height)	C (Depth)	D (Mtg. Dim.)	E (Mtg. Dim.)	F (Mtg. Dim.)
SMC-Flex Combination Controller									
5…25	152H,153H,152B,153B	—	1	16 (406)	24 (610)	10 (254)	0.75 (19)	22.5 (572)	14.5 (368)
		BP,NB,NI,6_		24 (610)	30 (762)	12 (305)		28.5 (724)	22.5 (572)
43	152H,153H,152B,153B	—	1	16 (406)	24 (610)	10 (254)	0.75 (19)	22.5 (572)	14.5 (368)
		BP, 6_		24 (610)	30 (762)	12 (305)		28.5 (724)	22.5 (572)
		NI, NB		30 (762)	38 (965)	14 (356)		36.5 (927)	28.5 (724)
60	153H, 153B	—	1	16 (406)	24 (610)	10 (254)	0.75 (19)	22.5 (572)	14.5 (368)
	152H, 153H,153B	6_		24 (610)	30 (762)	12 (305)		28.5 (724)	22.5 (572)
	152H,152B	—		24 (610)	30 (762)	12 (305)		28.5 (724)	22.5 (572)
	152H,152B, 153B,153H	NI, NB		30 (762)	38 (965)	14 (356)		36.5 (927)	28.5 (724)
85	153B, 153H	—	1	16 (406)	24 (610)	10 (254)	0.75 (19)	22.5 (572)	14.5 (368)
	152B,152H	—		24 (610)	30 (762)	12 (305)		28.5 (724)	22.5 (572)
	152H, 153H,153B	6_		24 (610)	30 (762)	12 (305)		28.5 (724)	22.5 (572)
	153H	BP		24 (610)	30 (762)	12 (305)		28.5 (724)	22.5 (572)
		BP , 6_		30 (762)	38 (965)	14 (356)		36.5 (927)	28.5 (724)
	152B, 152H,153B	BP,NB,NI		30 (762)	38 (965)	14 (356)		36.5 (927)	28.5 (724)
108	152H,153H	—	1	30 (762)	38 (965)	14 (356)	0.75 (19)	36.5 (927)	28.5 (724)
		6_		30 (762)	38 (965)	14 (356)		36.5 (927)	28.5 (724)
	153H,153B,152H,152B	BP, NB,NI		36 (914)	51 (1295)	14 (356)		49.5 (1257)	34.5 (876)
135	152H,153H	—	1	30 (762)	38 (965)	14 (356)	0.75 (19)	36.5 (927)	28.5 (724)
		6_		30 (762)	38 (965)	14 (356)		36.5 (927)	28.5 (724)
	152H,152B,153H,153B	BP, NB,NI		36 (914)	51 (1295)	14 (356)		49.5 (1257)	34.5 (876)
201	152H,153H	—	1	30 (762)	38 (965)	14 (356)	0.75 (19)	36.5 (927)	28.5 (724)
		6_		30 (762)	38 (965)	14 (356)		36.5 (927)	28.5 (724)
	152B,153B,153H,152H	BP, NB,NI		36 (914)	51 (1295)	14 (356)		49.5 (1257)	34.5 (876)
251	152H,153H	—	1	30 (762)	38 (965)	14 (356)	0.75 (19)	36.5 (927)	28.5 (724)
		6_		30 (762)	38 (965)	14 (356)		36.5 (927)	28.5 (724)
	152B,153B,153H,152H	BP, NB,NI		36 (914)	51 (1295)	14 (356)		49.5 (1257)	34.5 (876)
317	153H	—	1	36 (914)	51 (1295)	14 (356)	0.75 (19)	49.5 (1257)	34.5 (876)
		6_		36 (914)	51 (1295)	14 (356)		49.5 (1257)	34.5 (876)
		BP,NB		36 (914)	60 (1524)	14 (356)		58.5 (1486)	34.5 (876)
	153B	—		36 (914)	60 (1524)	14 (356)		58.5 (1486)	34.5 (876)
	152H,152B	—	2	38 (965)	60 (1524)	17 (431)	33.88 (861)	1.75 (45)	61.69 (1567)
		6_		38 (965)	60 (1524)	17 (431)		1.75 (45)	61.69 (1567)
	152B,153B,152H	NB,NI	3	40 (1016)	84 (2134)	18 (457)	—	—	—
361	153H	—	1	36 (914)	51 (1295)	14 (356)	0.75 (19)	49.5 (1257)	34.5 (876)
		6_		36 (914)	51 (1295)	14 (356)		49.5 (1257)	34.5 (876)
		BP		36 (914)	60 (1524)	14 (356)		58.5 (1486)	34.5 (876)
	153B	—		36 (914)	60 (1524)	14 (356)		58.5 (1486)	34.5 (876)
	152H, 152B	—	2	38 (965)	60 (1524)	17 (431)	33.88 (861)	1.75 (45)	61.69 (1567)
	152H	6_		38 (965)	60 (1524)	17 (431)		1.75 (45)	61.69 (1567)
	153H,152B,153B,152H	NB,NI	3	40 (1016)	84 (2134)	18 (457)	—	—	—
480	153H	—	1	36 (914)	51 (1295)	14 (356)	0.75 (19)	49.5 (1257)	34.5 (876)
		6_		36 (914)	51 (1295)	14 (356)		49.5 (1257)	34.5 (876)
	153H,153B	BP,NI	1❄	36 (914)	60 (1524)	14 (356)		58.5 (1486)	34.5 (876)
	152H	—	2∗‡	38 (965)	60 (1524)	17 (431)	33.88 (861)	1.75 (45)	61.69 (1567)
		BP		38 (965)	60 (1524)	17 (431)		1.75 (45)	61.69 (1567)
		NB	3∗‡	40 (1016)	84 (2134)	18 (457)	—	—	—
		—	4∗§	20 (508)	91.5 (2324)	20 (508)	—	—	—
	153H.153B	BP,NB,NI	3∗§	40 (1016)	84 (2134)	18 (457)	—	—	—
	152B	BP,NB,NI,6_	3∗	40 (1016)	84 (2134)	18 (457)			
	152H,152B	BP,NB,NI	4	35 (889)	91.5 (2324)	20 (508)			
625	152B	—	4	55 (1397)	91.5 (2324)	20 (508)	—	—	—
	152B,152H,153B,153H	NB		105 (2664)	91.5 (2324)	20 (508)			
	152H	—		55 (1397)	91.5 (2324)	20 (508)			
		BP		70 (1778)	91.5 (2324)	20 (508)			
	153B,153H	—		65 (1651)	91.5 (2324)	20 (508)			
780	152B	—	4	55 (1397)	91.5 (2324)	20 (508)	—	—	—
	152B,152H	BP,NI		70 (1778)	91.5 (2324)	20 (508)			
	152B,152H,153B,153H	NB		105 (2664)	91.5 (2324)	20 (508)			
	153B,153H	—		65 (1651)	91.5 (2324)	20 (508)			

∗ Assumed line voltage to be 480V AC. Different voltage may necessitate a bigger enclosure size. Consult your local Rockwell Automation sales office or Allen-Bradley distributor.
❄ 350 Hp max.
‡ 150 Hp @ 208V AC, 350 Hp @480V, 400…4500 Hp @ 600V
§ 200 Hp @ 240V AC, 400 Hp @480V, 5000 Hp @ 600V

Controller Rating [A]	Bulletin	With Option	Dimension Figure No.	Dimensions in inches (mm) A (Width)	B (Height)	C (Depth)	D (Mtg. Dim.)	E (Mtg. Dim.)	F (Mtg. Dim.)
Non-Combination Controller									
5…43	150	—	1	16 (406)	24 (610)	10 (254)	0.75 (19)	22.5 (572)	14.5 (368)
		6_	1✶	16 (406)	24 (610)	10 (254)		22.5 (572)	14.5 (368)
		BP	1	24 (610)	30 (762)	12 (305)		28.5 (724)	22.5 (572)
	150, 150B	NB,NI	1	24 (610)	30 (762)	305(12)		28.5 (724)	22.5 (572)
	150	NB,6P_	1❄	30 (762)	38 (965)	14 (356)		36.5 (927)	28.5 (724)
60	150	—	1	16 (406)	24 (610)	10 (254)	0.75 (19)	22.5 (572)	14.5 (368)
	150B	—		24 (610)	30 (762)	12 (305)		28.5 (724)	22.5 (572)
		BP		24 (610)	30 (762)	12 (305)		28.5 (724)	22.5 (572)
	150	6_	1❄	24 (610)	30 (762)	12 (305)		28.5 (724)	22.5 (572)
		NB	1	24 (610)	30 (762)	12 (305)		28.5 (724)	22.5 (572)
	150, 150B	NI		30 (762)	38 (965)	14 (356)		36.5 (927)	28.5 (724)
85	150	—	1	16 (406)	24 (610)	10 (254)	0.75 (19)	22.5 (572)	14.5 (368)
	150B	—		24 (610)	30 (762)	12 (305)		28.5 (724)	22.5 (572)
		BP		24 (610)	30 (762)	12 (305)		28.5 (724)	22.5 (572)
	150	NB		24 (610)	30 (762)	12 (305)		28.5 (724)	22.5 (572)
		6_	1❄	24 (610)	30 (762)	12 (305)		28.5 (724)	22.5 (572)
	150, 150B	NB,NI,6P_	1❄	30 (762)	38 (965)	14 (356)		36.5 (927)	28.5 (724)
108	150	—	1	24 (610)	30 (762)	12 (305)	0.75 (19)	28.5 (724)	22.5 (572)
		BP		30 (762)	38 (965)	14 (356)		36.5 (927)	28.5 (724)
		NB		30 (762)	38 (965)	14 (356)		36.5 (927)	28.5 (724)
	150B	—		30 (762)	38 (965)	14 (356)		36.5 (927)	28.5 (724)
		NB,NI		36 (914)	51 (1295)	14 (356)		49.5 (1257)	34.5 (876)
135	150	—	1	24 (610)	30 (762)	12 (305)	0.75 (19)	28.5 (724)	22.5 (572)
		BP		30 (762)	38 (965)	14 (356)		36.5 (927)	28.5 (724)
	150B	—		30 (762)	38 (965)	14 (356)		36.5 (927)	28.5 (724)
	150	NB		30 (762)	38 (965)	14 (356)		36.5 (927)	28.5 (724)
	150B	NB,NI		36 (914)	51 (1295)	14 (356)		49.5 (1257)	34.5 (876)
201	150	—	1	30 (762)	38 (965)	14 (356)	0.75 (19)	36.5 (927)	28.5 (724)
	150,150B	NB,NI,BP,6_		36 (914)	51 (1295)	14 (356)		49.5 (1257)	34.5 (876)
251	150	—	1	30 (762)	38 (965)	14 (356)	0.75 (19)	36.5 (927)	28.5 (724)
	150,150B	NB,NI,BP,6_		36 (914)	51 (1295)	14 (356)		49.5 (1257)	34.5 (876)
317	150	NB,NI,BP,6_	1	36 (914)	51 (1295)	14 (356)	0.75 (19)	49.5 (1257)	34.5 (876)
	150B	NB,NI,BP,6_		36 (914)	60 (1524)	14 (356)		58.5 (1486)	34.5 (876)
361	150	NB,NI,BP,6_	1	36 (914)	51 (1295)	14 (356)	0.75 (19)	49.5 (1257)	34.5 (876)
	150B	NB,NI,BP,6_		36 (914)	60 (1524)	14 (356)		58.5 (1486)	34.5 (876)
480	150	—	1	36 (914)	51 (1295)	14 (356)	0.75 (19)	49.5 (1257)	34.5 (876)
	150, 150B	BP,NB,NI		36 (914)	60 (1524)	14 (356)		58.5 (1486)	34.5 (876)
625	150	—	4	35 (889)	91.5 (2324)	20 (508)	—	—	—
		BP,NB		60 (1524)	91.5 (2324)	20 (508)			
	150B	—		60 (1524)	91.5 (2324)	20 (508)			
		NB		90 (2286)	91.5 (2324)	20 (508)			
780	150	—	4	35 (889)	91.5 (2324)	20 (508)	—	—	—
		BP,NB		60 (1524)	91.5 (2324)	20 (508)			
	150B	—		60 (1524)	91.5 (2324)	20 (508)			
		NB		90 (2286)	91.5 (2324)	20 (508)			

✶ Extra capacity transformer may require a larger enclosure; consult your local Rockwell Automation sales office or Allen-Bradley distributor.

❄ 1 kVA control transformers or larger extra capacity transformers may require a larger enclosure; consult your local Rockwell Automation sales office or Allen-Bradley distributor.

Bulletin 150 — Smart Motor Controllers — SMC™-3 Smart Motor Controller

The SMC-3 is a compact, simple to use, solid-state motor controller designed to operate 3-phase motors. It features a built-in overload relay and a built-in SCR bypass contactor on all three phases, allowing a smaller footprint than other soft starters on the market. This product is designed for many applications, including compressors, chillers, pumps, conveyors, and crushers. Modes of operation for the controller are as follows:

- Soft Start
- Soft Stop
- Current Limit Start
- Kick Start

The controllers offer two voltage ranges: 200…480V AC and 200…600V AC. All voltage ranges will operate at either 50 or 60 Hz.

- 1…480 A Range
- Built-In Electronic Motor Overload Protection
- Built-In SCR/Run Bypass
- Delta Compatibility

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This catalog is based on the **minimum** information needed to select an SMC soft starter for applications with low starting torque requirements. For product selection involving loads with high starting torque requirements (large fan, rock crusher, chipper, etc.), use of the free tools available from the Rockwell Automation Website is recommended:

http://www.ab.com/industrialcontrols/products/solid-state_motor_control/software/

Standards Compliance

UL 508
CSA C22.2 No.14
EN/IEC 60947-1
EN/IEC 60947-4-2

Certifications

cULus Listed (Open Type) (File No. E96956, Guides NMFT, NMFT7)
CSA Certified (File No. LR 1234)
CE Marked (Open Type) per EMC and Low Voltage Directive
CCC Certified

Modes of Operation

- Soft Start
- Selectable Kickstart
- Current Limit Start
- Soft Stop

Note: For detailed information about the different modes of operation, see page 4-109

Description of Features

Electronic Motor Overload Protection

The SMC-3 controller incorporates, as standard, electronic motor overload protection. This motor overload protection is accomplished electronically with the use of current transformers on each of the three phases. The controller's overload protection is programmable, providing the user with flexibility. The overload trip class selection consists of either OFF, 10, 15, or 20. The trip current is easily selected by adjusting the rotary potentiometer to the motor full-load current rating. Trip reset is selectable to either automatic or manual mode.

Note: Trip rating is 120% of dial setting.

Over-temperature

The SMC-3 monitors the SCR temperature by means of internal thermistors. When the power poles maximum rated temperature is reached, the microcomputer switches off the SMC, a TEMP fault is indicated via LED, and the 97/98 fault contact closes.

Phase Reversal Protection

When enabled via a DIP switch, 3-phase input power will be verified before starting. If input power phasing is detected to be incorrect, the start will be aborted and a fault indicated.

Phase Loss/Open Load

The unit will not attempt a start if there is a single-phase condition on the line. This protects from motor burnout during single-phase starting.

Phase Imbalance

The unit monitors for imbalance between phase currents. To prevent motor damage, the unit will trip if the difference between the minimum phase current and the maximum phase current exceeds 65% for 3 s, and a fault will be indicated.

Shorted SCR

Prior to every start and during starting, the unit will check all SCRs for shorts and unit load connections to the motor. If there is a shorted SCR in the SMC-3 and/or open load, the start will be aborted and a shorted SCR or open load fault will be indicated. This prevents damage from phase imbalance.

Push to Test

The unit with control wiring can be tested for fault conditions by using the Push to Test function. Hold down the Reset button for 7 s to activate the fault Aux (97, 98) and shut down the SMC-3. To clear, either push the Reset button or cycle control power to the device.

LED Description (Number of Flashes)

1. Overload
2. Overtemperature
3. Phase Reversal
4. Phase Loss/Open Load
5. Phase Imbalance
6. Shorted SCR
7. Test

Open and Non-Combination

150	–	C	30	F	B	D	–	8L
a		*b*	*c*	*d*	*e*	*f*		*g*

a

Bulletin Number	
Code	Description
150	Solid-State Controller

b

Controller Type	
Code	Description
C	SMC-3

c

Ampere Ratings	
Code	Description
3	3 A
9	9 A
16	16 A
19	19 A
25	25 A
30	30 A
37	37 A
43	43 A
60	60 A
85	85 A
108	108 A
135	135 A
201	201 A
251	251 A
317	317 A
361	361 A
480	480 A

d

Enclosure Type	
Code	Description
N	Open
F	NEMA 4/12 (IP65)

e

Input Line Voltage Open Type	
Code	Description
B	200…460V AC, 3-Phase, 50/60 Hz
C	200…600V AC, 3-Phase, 50/60 Hz
Non-Combination Enclosed Only	
H	200…208V AC, 3-Phase, 50/60 Hz
A	230V AC, 3-Phase, 50/60 Hz
B	400…460V AC, 3-Phase, 50/60 Hz
C	500…575V AC, 3-Phase, 50/60 Hz

f

Control Voltage	
Code	Description
D	100…240V AC
R	24V AC/DC (Open Type only)

g

Options (see page 4-148 for a full listing)	
Code	Description
8L	Line Mounted Protective Module (Enclosed Type only)
Load-side MOVs are not available when used with inside-the-delta connections. MOVs can be field installed for open type units.	

4

Combination

152H	–	C	30	F	BD	43	–	8L
a		*b*	*c*	*d*	*e*	*f*		*g*

a

Bulletin Number	
Code	Description
152H	Solid-State Controller with Fusible Disconnect
153H	Solid-State Controller with Circuit Breaker

b

Controller Type	
Code	Description
C	SMC-3

c

Ampere Ratings	
Code	Description
3	3 A
9	9 A
16	16 A
19	19 A
25	25 A
30	30 A
37	37 A
43	43 A
60	60 A
85	85 A
108	108 A
135	135 A
201	201 A
251	251 A
317	317 A
361	361 A
480	480 A

d

Enclosure Type	
Code	Description
F	NEMA Type 4/12 (IP65)
J	NEMA Type 12 (IP54)
X	NEMA Type 3R (IP44)

e

Input Line Voltage Open Type	
Code	Description
HD	200…208V AC, 3-Phase, 50/60 Hz
AD	230V AC, 3-Phase, 50/60 Hz
BD	400…460V AC, 3-Phase, 50/60 Hz
CD	500…575V AC, 3-Phase, 50/60 Hz

g

Options (see page 4-148 for a full listing)	
Code	Description
8L	Line Mounted Protective Module (Enclosed Type only)
Load-side MOVs are not available when used with inside-the-delta connections.	

f

Horsepower									
Cat. No.	Hp Rating	Cat. No.	Hp Rating	Cat. No.	Hp Rating	Cat. No.	Hp Rating	Cat. No.	Hp Rating
33	0.5	39	5	46	40	52	150	60	450
34	0.75	40	7.5	47	50	54	200	61	500
35	1	41	10	48	60	56	250	62	600
36	1.5	42	15	49	75	57	300	63	700
37	2	43	20	50	100	58	350	65	800
38	3	44	25	51	125	59	400	67	1000
—	—	45	30	—	—	—	—	—	—

Open Type and Non-Combination Enclosed (IP65, NEMA 4/12) Controllers — For use with Line-Connected Motors

Rated Voltage [V AC]	Motor Current [A]❄	Max. kW, 50 Hz	Max. Hp, 60 Hz	Control Power	Open Type — Line-Connected Motors	IP65 (Type 4/12) Enclosed Non-Combination Controllers§
					Cat. No.	Cat. No.
200/208	1…3	—	0.5	100…240V AC, 50/60 Hz	**150-C3NBD**	150-C3FHD
		—		24V AC/DC	**150-C3NBR**	—
	3…9	—	0.75…2	100…240V AC, 50/60 Hz	**150-C9NBD**	150-C9FHD
		—		24V AC/DC	**150-C9NBR**	—
	5.3…16	—	1.5…3	100…240V AC, 50/60 Hz	**150-C16NBD**	150-C16FHD
		—		24V AC/DC	**150-C16NBR**	—
	6.3…19	—	1.5…3	100…240V AC, 50/60 Hz	150-C19NBD	150-C25FHD
		—		24V AC/DC	**150-C19NBR**	—
	9.2…25	—	3…7.5	100…240V AC, 50/60 Hz	**150-C25NBD**	150-C25FHD
		—		24V AC/DC	**150-C25NBR**	—
	10…30	—	3…7.5	100…240V AC, 50/60 Hz	**150-C30NBD**	150-C30FHD
		—		24V AC/DC	**150-C30NBR**	—
	12.3…37	—	5…10	100…240V AC, 50/60 Hz	**150-C37NBD**	150-C37FHD
		—		24V AC/DC	**150-C37NBR**	—
	14.3…43	—	5…10	100…240V AC, 50/60 Hz	**150-C43NBD**	150-C43FHD
		—		24V AC/DC	**150-C43NBR**	—
	20…60	—	7.5…15	100…240V AC, 50/60 Hz	**150-C60NBD**	150-C60FHD
		—		24V AC/DC	**150-C60NBR**	—
	28.3…85	—	10…25	100…240V AC, 50/60 Hz	**150-C85NBD**	150-C85FHD
		—		24V AC/DC	**150-C85NBR**	—
	27…108	—	20…30	100…240V AC, 50/60 Hz	**150-C108NBD**	150-C108FHD
		—		24V AC/DC♣	**150-C108NBR**	—
	34…135	—	25…40	100…240V AC, 50/60 Hz	**150-C135NBD**	150-C135FHD
		—		24V AC/DC♣	**150-C135NBR**	—
	67…201	—	40…60	100…240V AC, 50/60 Hz	**150-C201NBD**	150-C201FHD
		—		24V AC/DC♣	**150-C201NBR**	—
	84…251	—	50…75	100…240V AC, 50/60 Hz	**150-C251NBD**	150-C251FHD
		—		24V AC/DC♣	**150-C251NBR**	—
	106…317	—	60…100	100…240V AC, 50/60 Hz	**150-C317NBD**	150-C317FHD
		—		24V AC/DC♣	**150-C317NBR**	—
	120…361	—	75…125	100…240V AC, 50/60 Hz	**150-C361NBD**	150-C361FHD
		—		24V AC/DC♣	**150-C361NBR**	—
	160…480	—	100…150	100…240V AC, 50/60 Hz	**150-C480NBD**	150-C480FHD
		—		24V AC/DC♣	**150-C480NBR**	—

❄ Motor FLA rating should fall within specified current range for unit to operate properly.
§ These controllers require a separate 100…240V, 50/60 Hz single-phase control source. To add a control circuit transformer to the enclosure, add the appropriate option code to the catalog string.
♣ Separate 120V or 240V single phase is required for fan operation.

Open Type and Non-Combination Enclosed (IP65, NEMA 4/12) Controllers — For use with Line-Connected Motors, Continued

Rated Voltage [V AC]	Motor Current [A]❄	Max. kW, 50 Hz	Max. Hp, 60 Hz	Control Power	Open Type — Line-Connected Motors	IP65 (Type 4/12) Enclosed Non-Combination Controllers§
					Cat. No.	Cat. No.
230	1…3	0.55	0.5	100…240V AC, 50/60 Hz	**150-C3NBD**	150-C3FAD
				24V AC/DC	**150-C3NBR**	—
	3…9	2.2	0.75…2	100…240V AC, 50/60 Hz	**150-C9NBD**	150-C9FAD
				24V AC/DC	**150-C9NBR**	—
	5.3…16	4	1.5…5	100…240V AC, 50/60 Hz	**150-C16NBD**	150-C16FAD
				24V AC/DC	**150-C16NBR**	—
	6.3…19	4	2…5	100…240V AC, 50/60 Hz	150-C19NBD	150-C25FAD
				24V AC/DC	**150-C19NBR**	—
	9.2…25	5.5	3…7.5	100…240V AC, 50/60 Hz	**150-C25NBD**	150-C25FAD
				24V AC/DC	**150-C25NBR**	—
	10…30	7.5	5…10	100…240V AC, 50/60 Hz	**150-C30NBD**	150-C30FAD
				24V AC/DC	**150-C30NBR**	—
	12.3…37	7.5	5…10	100…240V AC, 50/60 Hz	**150-C37NBD**	150-C37FAD
				24V AC/DC	**150-C37NBR**	—
	14.3…43	11	5…15	100…240V AC, 50/60 Hz	**150-C43NBD**	150-C43FAD
				24V AC/DC	**150-C43NBR**	—
	20…60	15	7.5…20	100…240V AC, 50/60 Hz	**150-C60NBD**	150-C60FAD
				24V AC/DC	**150-C60NBR**	—
	28.3…85	22	15…30	100…240V AC, 50/60 Hz	**150-C85NBD**	150-C85FAD
				24V AC/DC	**150-C85NBR**	—
	27…108	30	20…40	100…240V AC, 50/60 Hz	**150-C108NBD**	150-C108FAD
				24V AC/DC♣	**150-C108NBR**	—
	34…135	37	25…50	100…240V AC, 50/60 Hz	**150-C135NBD**	150-C135FAD
				24V AC/DC♣	**150-C135NBR**	—
	67…201	55	40…75	100…240V AC, 50/60 Hz	**150-C201NBD**	150-C201FAD
				24V AC/DC♣	**150-C201NBR**	—
	84…251	75	50…100	100…240V AC, 50/60 Hz	**150-C251NBD**	150-C251FAD
				24V AC/DC♣	**150-C251NBR**	—
	106…317	90	60…125	100…240V AC, 50/60 Hz	**150-C317NBD**	150-C317FAD
				24V AC/DC♣	**150-C317NBR**	—
	120…361	110	75…150	100…240V AC, 50/60 Hz	**150-C361NBD**	150-C361FAD
				24V AC/DC♣	**150-C361NBR**	—
	160…480	132	100…200	100…240V AC, 50/60 Hz	**150-C480NBD**	150-C480FAD
				24V AC/DC♣	**150-C480NBR**	—

❄ Motor FLA rating should fall within specified current range for unit to operate properly.

§ These controllers require a separate 100…240V, 50/60 Hz single-phase control source. To add a control circuit transformer to the enclosure, add the appropriate option code to the catalog string.

♣ Separate 120V or 240V single phase is required for fan operation.

Open Type and Non-Combination Enclosed (IP65, NEMA 4/12) Controllers — For use with Line-Connected Motors, Continued

Rated Voltage [V AC]	Motor Current [A]❄	Max. kW, 50 Hz	Max. Hp, 60 Hz	Control Power	Open Type — Line-Connected Motors	IP65 (Type 4/12) Enclosed Non-Combination Controllers§
					Cat. No.	Cat. No.
380/400/415/460	1…3	1.1	0.5…1.5	100…240V AC, 50/60 Hz	**150-C3NBD**	150-C3FBD
				24V AC/DC	**150-C3NBR**	—
	3…9	4	1.5…5	100…240V AC, 50/60 Hz	**150-C9NBD**	150-C9FBD
				24V AC/DC	**150-C9NBR**	—
	5.3…16	7.5	5…10	100…240V AC, 50/60 Hz	**150-C16NBD**	150-C16FBD
				24V AC/DC	**150-C16NBR**	—
	6.3…19	7.5	5…10	100…240V AC, 50/60 Hz	150-C19NBD	**150-C19NBR**
				24V AC/DC	**150-C19NBR**	—
	9.2…25	11	7.5…15	100…240V AC, 50/60 Hz	**150-C25NBD**	**150-C25NBR**
				24V AC/DC	**150-C25NBR**	—
	10…30	15	7.5…20	100…240V AC, 50/60 Hz	**150-C30NBD**	150-C30FBD
				24V AC/DC	**150-C30NBR**	—
	12.3…37	18.5	10…25	100…240V AC, 50/60 Hz	**150-C37NBD**	150-C37FBD
				24V AC/DC	**150-C37NBR**	—
	14.3…43	22	10…30	100…240V AC, 50/60 Hz	**150-C43NBD**	150-C43FBD
				24V AC/DC	**150-C43NBR**	—
	20…60	30	15…40	100…240V AC, 50/60 Hz	**150-C60NBD**	150-C60FBD
				24V AC/DC	**150-C60NBR**	—
	28.3…85	45	25…60	100…240V AC, 50/60 Hz	**150-C85NBD**	150-C85FBD
				24V AC/DC	**150-C85NBR**	—
	27…108	55	50…75	100…240V AC, 50/60 Hz	**150-C108NBD**	150-C108FBD
				24V AC/DC♣	**150-C108NBR**	—
	34…135	75	60…100	100…240V AC, 50/60 Hz	**150-C135NBD**	150-C135FBD
				24V AC/DC♣	**150-C135NBR**	—
	67…201	95…110	75…150	100…240V AC, 50/60 Hz	**150-C201NBD**	150-C201FBD
				24V AC/DC♣	**150-C201NBR**	—
	84…251	95…132	100…200	100…240V AC, 50/60 Hz	**150-C251NBD**	150-C251FBD
				24V AC/DC♣	**150-C251NBR**	—
	106…317	95…160	125…250	100…240V AC, 50/60 Hz	**150-C317NBD**	150-C317FBD
				24V AC/DC♣	**150-C317NBR**	—
	120…361	110…200	250…300	100…240V AC, 50/60 Hz	**150-C361NBD**	150-C361FBD
				24V AC/DC♣	**150-C361NBR**	—
	160…480	160…250	300…400	100…240V AC, 50/60 Hz	**150-C480NBD**	150-C480FBD
				24V AC/DC♣	**150-C480NBR**	—

❄ Motor FLA rating should fall within specified current range for unit to operate properly.

§ These controllers require a separate 100…240V, 50/60 Hz single-phase control source. To add a control circuit transformer to the enclosure, add the appropriate option code to the catalog string.

♣ Separate 120V or 240V single phase is required for fan operation.

Open Type and Non-Combination Enclosed (IP65, NEMA 4/12) Controllers — For use with Line-Connected Motors, Continued

Rated Voltage [V AC]	Motor Current [A]❄	Max. kW, 50 Hz	Max. Hp, 60 Hz	Control Power	Open Type — Line-Connected Motors	IP65 (Type 4/12) Enclosed Non-Combination Controllers§
					Cat. No.	Cat. No.
500/575	1…3	1.5	0.75…2	100…240V AC, 50/60 Hz	150-C3NCD	150-C3FCD
				24V AC/DC	**150-C3NCR**	—
	3…9	5.5	3…7.5	100…240V AC, 50/60 Hz	150-C9NCD	150-C9FCD
				24V AC/DC	150-C9NCR	—
	5.3…16	7.5	5…10	100…240V AC, 50/60 Hz	150-C16NCD	150-C16FCD
				24V AC/DC	150-C16NCR	—
	6.3…19	11	7.5…15	100…240V AC, 50/60 Hz	150-C19NCD	150-C25FCD
				24V AC/DC	150-C19NCR	—
	9.2…25	15	7.5…20	100…240V AC, 50/60 Hz	**150-C25NCD**	150-C25FCD
				24V AC/DC	**150-C25NCR**	—
	10…30	18.5	10…25	100…240V AC, 50/60 Hz	**150-C30NCD**	150-C30FCD
				24V AC/DC	150-C30NCR	—
	12.3…37	22	15…30	100…240V AC, 50/60 Hz	**150-C37NCD**	150-C37FCD
				24V AC/DC	**150-C37NCR**	—
	14.3…43	22	15…40	100…240V AC, 50/60 Hz	**150-C43NCD**	150-C43FCD
				24V AC/DC	150-C43NCR	—
	20…60	37	20…50	100…240V AC, 50/60 Hz	**150-C60NCD**	150-C60FCD
				24V AC/DC	150-C60NCR	—
	28.3…85	55	30…75	100…240V AC, 50/60 Hz	**150-C85NCD**	150-C85FCD
				24V AC/DC	150-C85NCR	—
	27…108	75	60…100	100…240V AC, 50/60 Hz	**150-C108NCD**	150-C108FCD
				24V AC/DC♣	**150-C108NCR**	—
	34…135	90	75…125	100…240V AC, 50/60 Hz	**150-C135NCD**	150-C135FCD
				24V AC/DC♣	**150-C135NCR**	—
	67…201	75…132	100…200	100…240V AC, 50/60 Hz	**150-C201NCD**	150-C201FCD
				24V AC/DC♣	**150-C201NCR**	—
	84…251	90…160	125…250	100…240V AC, 50/60 Hz	**150-C251NCD**	150-C251FCD
				24V AC/DC♣	**150-C251NCR**	—
	106…317	100…200	200…300	100…240V AC, 50/60 Hz	**150-C317NCD**	150-C317FCD
				24V AC/DC♣	**150-C317NCR**	—
	120…361	132…250	200…350	100…240V AC, 50/60 Hz	**150-C361NCD**	150-C361FCD
				24V AC/DC♣	**150-C361NCR**	—
	160…480	200…315	250…500	100…240V AC, 50/60 Hz	**150-C480NCD**	150-C480FCD
				24V AC/DC♣	**150-C480NCR**	—

❄ Motor FLA rating should fall within specified current range for unit to operate properly.

§ These controllers require a separate 100…240V, 50/60 Hz single-phase control source. To add a control circuit transformer to the enclosure, add the appropriate option code to the catalog string.

♣ Separate 120V or 240V single phase is required for fan operation.

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Open Type Controllers — For use with Delta-Connected Motors

Rated Voltage [V AC]	Motor Current [A]❄	Max. kW, 50 Hz	Max. Hp, 60 Hz	Control Power	Open Type Cat. No.
200/208	1.7…5.1	—	1	100…240V AC, 50/60 Hz	**150-C3NBD**
		—		24V AC/DC	**150-C3NBR**
	5.1…16	—	1.5…3	100…240V AC, 50/60 Hz	**150-C9NBD**
		—		24V AC/DC	**150-C9NBR**
	9.1…27.6	—	3…7.5	100…240V AC, 50/60 Hz	**150-C16NBD**
		—		24V AC/DC	**150-C16NBR**
	10.9…32.8	—	3…10	100…240V AC, 50/60 Hz	150-C19NBD
		—		24V AC/DC	**150-C19NBR**
	14.3…43	—	3…10	100…240V AC, 50/60 Hz	**150-C25NBD**
		—		24V AC/DC	**150-C25NBR**
	17.3…52	—	5…10	100…240V AC, 50/60 Hz	**150-C30NBD**
		—		24V AC/DC	**150-C30NBR**
	21…64	—	7.5…20	100…240V AC, 50/60 Hz	**150-C37NBD**
		—		24V AC/DC	**150-C37NBR**
	25…74	—	7.5…20	100…240V AC, 50/60 Hz	**150-C43NBD**
		—		24V AC/DC	**150-C43NBR**
	34.6…104	—	15…30	100…240V AC, 50/60 Hz	**150-C60NBD**
		—		24V AC/DC	**150-C60NBR**
	50…147	—	15…40	100…240V AC, 50/60 Hz	**150-C85NBD**
		—		24V AC/DC	**150-C85NBR**
	47…187	—	20…60	100…240V AC, 50/60 Hz	**150-C108NBD**
		—		24V AC/DC♣	**150-C108NBR**
	59…234	—	20…75	100…240V AC, 50/60 Hz	**150-C135NBD**
		—		24V AC/DC♣	**150-C135NBR**
	116…348	—	75…100	100…240V AC, 50/60 Hz	**150-C201NBD**
		—		24V AC/DC♣	**150-C201NBR**
	145…435	—	100…150	100…240V AC, 50/60 Hz	**150-C251NBD**
		—		24V AC/DC♣	**150-C251NBR**
	183…549	—	100…200	100…240V AC, 50/60 Hz	**150-C317NBD**
		—		24V AC/DC♣	**150-C317NBR**
	208…625	—	125…200	100…240V AC, 50/60 Hz	**150-C361NBD**
		—		24V AC/DC♣	**150-C361NBR**
	277…831	—	200…300	100…240V AC, 50/60 Hz	**150-C480NBD**
		—		24V AC/DC♣	**150-C480NBR**

❄ Motor FLA rating should fall within specified current range for unit to operate properly.
♣ Separate 120V or 240V single phase is required for fan operation.

Open Type Controllers — For use with Delta-Connected Motors, Continued

Rated Voltage [V AC]	Motor Current [A]❄	Max. kW, 50 Hz	Max. Hp, 60 Hz	Control Power	Open Type Cat. No.
230	1.7…5.1	0.25…1.1	1	100…240V AC, 50/60 Hz	**150-C3NBD**
				24V AC/DC	**150-C3NBR**
	5.1…16	1.1…4	1…5	100…240V AC, 50/60 Hz	**150-C9NBD**
				24V AC/DC	**150-C9NBR**
	9.1…27.6	2.2…7.5	3…7.5	100…240V AC, 50/60 Hz	**150-C16NBD**
				24V AC/DC	**150-C16NBR**
	10.9…32.8	2.2…7.5	3…10	100…240V AC, 50/60 Hz	150-C19NBD
				24V AC/DC	**150-C19NBR**
	14.3…43	4…11	3…15	100…240V AC, 50/60 Hz	**150-C25NBD**
				24V AC/DC	**150-C25NBR**
	17.3…52	4…15	5…15	100…240V AC, 50/60 Hz	**150-C30NBD**
				24V AC/DC	**150-C30NBR**
	21…64	5.5…18.5	7.5…20	100…240V AC, 50/60 Hz	**150-C37NBD**
				24V AC/DC	**150-C37NBR**
	25…74	5.5…22	7.5…25	100…240V AC, 50/60 Hz	**150-C43NBD**
				24V AC/DC	**150-C43NBR**
	34.6…104	7.5…30	15…40	100…240V AC, 50/60 Hz	**150-C60NBD**
				24V AC/DC	**150-C60NBR**
	50…147	15…45	20…50	100…240V AC, 50/60 Hz	**150-C85NBD**
				24V AC/DC	**150-C85NBR**
	47…187	55	20…60	100…240V AC, 50/60 Hz	**150-C108NBD**
				24V AC/DC♣	**150-C108NBR**
	59…234	75	25…75	100…240V AC, 50/60 Hz	**150-C135NBD**
				24V AC/DC♣	**150-C135NBR**
	116…348	110	75…125	100…240V AC, 50/60 Hz	**150-C201NBD**
				24V AC/DC♣	**150-C201NBR**
	145…435	132	100…150	100…240V AC, 50/60 Hz	**150-C251NBD**
				24V AC/DC♣	**150-C251NBR**
	183…549	160	125…200	100…240V AC, 50/60 Hz	**150-C317NBD**
				24V AC/DC♣	**150-C317NBR**
	208…625	200	150…250	100…240V AC, 50/60 Hz	**150-C361NBD**
				24V AC/DC♣	**150-C361NBR**
	277…831	250	200…300	100…240V AC, 50/60 Hz	**150-C480NBD**
				24V AC/DC♣	**150-C480NBR**

❄ Motor FLA rating should fall within specified current range for unit to operate properly.
♣ Separate 120V or 240V single phase is required for fan operation.

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Open Type Controllers — For use with Delta-Connected Motors, Continued

Rated Voltage [V AC]	Motor Current [A]❄	Max. kW, 50 Hz	Max. Hp, 60 Hz	Control Power	Open Type Cat. No.
380/400/415/460	1.7…5.1	0.55…2.2	0.5…2	100…240V AC, 50/60 Hz	**150-C3NBD**
				24V AC/DC	**150-C3NBR**
	5.1…16	2.2…7.5	2…7.5	100…240V AC, 50/60 Hz	**150-C9NBD**
				24V AC/DC	**150-C9NBR**
	9.1…27.6	4…11	5…15	100…240V AC, 50/60 Hz	**150-C16NBD**
				24V AC/DC	**150-C16NBR**
	10.9…32.8	4…15	5…15	100…240V AC, 50/60 Hz	150-C19NBD
				24V AC/DC	**150-C19NBR**
	14.3…43	5.5…22	7.5…20	100…240V AC, 50/60 Hz	**150-C25NBD**
				24V AC/DC	**150-C25NBR**
	17.3…52	7.5…22	7.5…30	100…240V AC, 50/60 Hz	**150-C30NBD**
				24V AC/DC	**150-C30NBR**
	21…64	7.5…30	10…40	100…240V AC, 50/60 Hz	**150-C37NBD**
				24V AC/DC	**150-C37NBR**
	25…74	11…37	10…50	100…240V AC, 50/60 Hz	**150-C43NBD**
				24V AC/DC	**150-C43NBR**
	34.6…104	15…55	20…75	100…240V AC, 50/60 Hz	**150-C60NBD**
				24V AC/DC	**150-C60NBR**
	50…147	22…75	25…100	100…240V AC, 50/60 Hz	**150-C85NBD**
				24V AC/DC	**150-C85NBR**
	47…187	90	40…150	100…240V AC, 50/60 Hz	**150-C108NBD**
				24V AC/DC♣	**150-C108NBR**
	59…234	132	50…150	100…240V AC, 50/60 Hz	**150-C135NBD**
				24V AC/DC♣	**150-C135NBR**
	116…348	160	150…250	100…240V AC, 50/60 Hz	**150-C201NBD**
				24V AC/DC♣	**150-C201NBR**
	145…435	250	200…350	100…240V AC, 50/60 Hz	**150-C251NBD**
				24V AC/DC♣	**150-C251NBR**
	183…549	315	250…450	100…240V AC, 50/60 Hz	**150-C317NBD**
				24V AC/DC♣	**150-C317NBR**
	208…625	355	300…500	100…240V AC, 50/60 Hz	**150-C361NBD**
				24V AC/DC♣	**150-C361NBR**
	277…831	450	350…700	100…240V AC, 50/60 Hz	**150-C480NBD**
				24V AC/DC♣	**150-C480NBR**

❄ Motor FLA rating should fall within specified current range for unit to operate properly.
♣ Separate 120V or 240V single phase is required for fan operation.

Open Type Controllers — For use with Delta-Connected Motors, Continued

Rated Voltage [V AC]	Motor Current [A]❄	Max. kW, 50 Hz	Max. Hp, 60 Hz	Control Power	Open Type Cat. No.
500/575	1.7…5.1	0.75…3	1…3	100…240V AC, 50/60 Hz	150-C3NCD
				24V AC/DC	**150-C3NCR**
	5.1…16	3…7.5	3…10	100…240V AC, 50/60 Hz	150-C9NCD
				24V AC/DC	150-C9NCR
	9.1…27.6	5.5…15	7.5…20	100…240V AC, 50/60 Hz	150-C16NCD
				24V AC/DC	150-C16NCR
	10.9…32.8	5.5…22	7.5…30	100…240V AC, 50/60 Hz	150-C19NCD
				24V AC/DC	150-C19NCR
	14.3…43	7.5…22	10…40	100…240V AC, 50/60 Hz	**150-C25NCD**
				24V AC/DC	**150-C25NCR**
	17.3…52	11…30	15…50	100…240V AC, 50/60 Hz	**150-C30NCD**
				24V AC/DC	150-C30NCR
	21…64	11…37	15…60	100…240V AC, 50/60 Hz	**150-C37NCD**
				24V AC/DC	**150-C37NCR**
	25…74	15…45	20…60	100…240V AC, 50/60 Hz	**150-C43NCD**
				24V AC/DC	150-C43NCR
	34.6…104	22…55	30…100	100…240V AC, 50/60 Hz	**150-C60NCD**
				24V AC/DC	150-C60NCR
	50…147	30…90	40…150	100…240V AC, 50/60 Hz	**150-C85NCD**
				24V AC/DC	150-C85NCR
	47…187	132	50…150	100…240V AC, 50/60 Hz	**150-C108NCD**
				24V AC/DC♣	**150-C108NCR**
	59…234	160	60…200	100…240V AC, 50/60 Hz	**150-C135NCD**
				24V AC/DC♣	**150-C135NCR**
	116…348	250	250…300	100…240V AC, 50/60 Hz	**150-C201NCD**
				24V AC/DC♣	**150-C201NCR**
	145…435	315	250…400	100…240V AC, 50/60 Hz	**150-C251NCD**
				24V AC/DC♣	**150-C251NCR**
	183…549	400	300…500	100…240V AC, 50/60 Hz	**150-C317NCD**
				24V AC/DC♣	**150-C317NCR**
	208…625	450	350…600	100…240V AC, 50/60 Hz	**150-C361NCD**
				24V AC/DC♣	**150-C361NCR**
	277…831	560	400…900	100…240V AC, 50/60 Hz	**150-C480NCD**
				24V AC/DC♣	**150-C480NCR**

❄ Motor FLA rating should fall within specified current range for unit to operate properly.
♣ Separate 120V or 240V single phase is required for fan operation.

Combination Enclosed (IP65, NEMA 4/12) Controllers with Fusible Disconnect or Circuit Breaker

Rated Voltage [V AC]	Current Rating [A]	kW	Hp	IP65 (Type 4/12) Enclosed Combination Controllers with Fusible Disconnect ❄ Cat. No.	IP65 (Type 4/12) Enclosed Combination Controllers with Circuit Breaker ❄ Cat. No.
200/208	3	—	0.5	152H-C3FHD-33	153H-C3FHD-33
	9	—	0.75	152H-C9FHD-34	153H-C9FHD-34
	9	—	1	152H-C9FHD-35	153H-C9FHD-35
	9	—	1.5	152H-C9FHD-36	153H-C9FHD-36
	16	—	2	152H-C16FHD-37	153H-C16FHD-37
	16	—	3	152H-C16FHD-38	153H-C16FHD-38
	25	—	5	152H-C25FHD-39	153H-C25FHD-39
	37	—	7.5	152H-C37FHD-40	153H-C37FHD-40
	43	—	10	152H-C43FHD-41	153H-C43FHD-41
	60	—	15	152H-C60FHD-42	153H-C60FHD-42
	85	—	20	152H-C85FHD-43	153H-C85FHD-43
	85	—	25	152H-C85FHD-44	153H-C85FHD-44
	108	—	30	152H-C108FHD-45	153H-C108FHD-45
	135	—	40	152H-C135FHD-46	153H-C135FHD-46
	201	—	60	152H-C201FHD-48	153H-C201FHD-48
	251	—	75	152H-C251FHD-49	153H-C251FHD-49
	317	—	100	152H-C317FHD-50	153H-C317FHD-50
	361	—	125	152H-C361FHD-51	153H-C361FHD-51
	480	—	150	152H-C480FHD-52	153H-C480FHD-52
230	3	0.37	0.5	152H-C3FAD-33	153H-C3FAD-33
	9	0.55	0.75	152H-C9FAD-34	153H-C9FAD-34
	9	0.75	1	152H-C9FAD-35	153H-C9FAD-35
	9	1.1	1.5	152H-C9FAD-36	153H-C9FAD-36
	9	1.5	2	152H-C9FAD-37	153H-C9FAD-37
	16	2.2	3	152H-C16FAD-38	153H-C16FAD-38
	25	3.7	5	152H-C25FAD-39	153H-C25FAD-39
	30	5.5	7.5	152H-C30FAD-40	153H-C30FAD-40
	37	7.5	10	152H-C37FAD-41	153H-C37FAD-41
	43	11	15	152H-C43FAD-42	153H-C43FAD-42
	60	15	20	152H-C60FAD-43	153H-C60FAD-43
	85	18.5	25	152H-C85FAD-44	153H-C85FAD-44
	85	22	30	152H-C85FAD-45	153H-C85FAD-45
	108	30	40	152H-C108FAD-46	153H-C108FAD-46
	135	37	50	152H-C135FAD-47	153H-C135FAD-47
	201	55	75	152H-C201FAD-49	153H-C201FAD-49
	251	75	100	152H-C251FAD-50	153H-C251FAD-50
	317	90	125	152H-C317FAD-51	153H-C317FAD-51
	361	110	150	152H-C361FAD-52	153H-C361FAD-52
	480	147	200	§ 152H-C480JAD-54	153H-C480FAD-54

❄ These controllers require a separate 100…240V, 50/60 Hz single-phase control source. To add a control circuit transformer to the enclosure, add the appropriate option code to the catalog string.
§ Available in IP54 (Type 12) enclosure only.

Combination Enclosed (IP65, NEMA 4/12) Controllers with Fusible Disconnect or Circuit Breaker, Continued

Rated Voltage [V AC]	Current Rating [A]	kW	Hp	IP65 (Type 4/12) Enclosed Combination Controllers with Fusible Disconnect ❄ Cat. No.	IP65 (Type 4/12) Enclosed Combination Controllers with Circuit Breaker ❄ Cat. No.
460	3	0.37	0.5	152H-C3FBD-33	153H-C3FBD-33
	3	0.55	0.75	152H-C3FBD-34	153H-C3FBD-34
	3	0.75	1	152H-C3FBD-35	153H-C3FBD-35
	9	1.1	1.5	152H-C9FBD-36	153H-C9FBD-36
	9	1.5	2	152H-C9FBD-37	153H-C9FBD-37
	9	2.2	3	152H-C9FBD-38	153H-C9FBD-38
	16	3.7	5	152H-C16FBD-39	153H-C16FBD-39
	16	5.5	7.5	152H-C16FBD-40	153H-C16FBD-40
	25	7.5	10	152H-C25FBD-41	153H-C25FBD-41
	30	11	15	152H-C30FBD-42	153H-C30FBD-42
	37	15	20	152H-C37FBD-43	153H-C37FBD-43
	43	18.5	25	152H-C43FBD-44	153H-C43FBD-44
	43	22	30	152H-C43FBD-45	153H-C43FBD-45
	60	30	40	152H-C60FBD-46	153H-C60FBD-46
	85	37	50	152H-C85FBD-47	153H-C85FBD-47
	85	45	60	152H-C85FBD-48	153H-C85FBD-48
	108	55	75	152H-C108FBD-49	153H-C108FBD-49
	135	75	100	152H-C135FBD-50	153H-C135FBD-50
	201	110	150	152H-C201FBD-52	153H-C201FBD-52
	251	132	200	152H-C251FBD-54	153H-C251FBD-54
	317	160	250	152H-C317FBD-56	153H-C317FBD-56
	361	200	300	152H-C361FBD-57	153H-C361FBD-57
	480	250	400	§ 152H-C480JBD-59	153H-C480FBD-59
500/575	3	0.55	0.75	152H-C3FCD-34	153H-C3FCD-34
	3	0.75	1	152H-C3FCD-35	153H-C3FCD-35
	9	1.1	1.5	152H-C9FCD-36	153H-C9FCD-36
	9	1.5	2	152H-C9FCD-37	153H-C9FCD-37
	9	2.2	3	152H-C9FCD-38	153H-C9FCD-38
	9	3.7	5	152H-C9FCD-39	153H-C9FCD-39
	16	5.5	7.5	152H-C16FCD-40	153H-C16FCD-40
	16	7.5	10	152H-C16FCD-41	153H-C16FCD-41
	25	11	15	152H-C25FCD-42	153H-C25FCD-42
	30	15	20	152H-C30FCD-43	153H-C30FCD-43
	37	18.5	25	152H-C37FCD-44	153H-C37FCD-44
	43	22	30	152H-C43FCD-45	153H-C43FCD-45
	43	30	40	152H-C43FCD-46	153H-C43FCD-46
	60	37	50	152H-C60FCD-47	153H-C60FCD-47
	85	45	60	152H-C85FCD-48	153H-C85FCD-48
	85	55	75	152H-C85FCD-49	153H-C85FCD-49
	108	75	100	152H-C108FCD-50	153H-C108FCD-50
	135	90	125	152H-C135FCD-51	153H-C135FCD-51
	201	132	200	152H-C201FCD-54	153H-C201FCD-54
	251	160	250	152H-C251FCD-56	153H-C251FCD-56
	317	200	300	152H-C317FCD-57	153H-C317FCD-57
	361	250	350	152H-C361FCD-58	153H-C361FCD-58
	480	315	500	§ 152H-C480JCD-61	153H-C480FCD-61

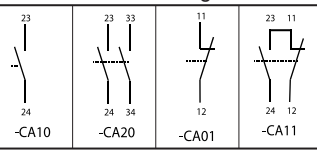
❄ These controllers require a separate 100…240V, 50/60 Hz single-phase control source. To add a control circuit transformer to the enclosure, add the appropriate option code to the catalog string.
§ Available in IP54 (Type 12) enclosure only.

Enclosed Options

Option	Description		Cat. No. Modification
Push Buttons	Start-Stop Push Button		-1
Selector Switch	Hand-Off-Auto Selector Switch		-3
Pilot Light	Transformer Pilot Light - Red Run Indicator		-4R
Control Circuit Transformer	Control Circuit Transformer (fused primary and secondary)		-6P
Protective Module	480V Line Side Protective Module	3…480 A	-8L
	600V Line Side Protective Module	3…480 A	
	480V Load Side Protective Module	43…480 A	-8M
	600V Load Side Protective Module	43…480 A	
	480V Both Line and Load Side Protective Module	43…480 A	-8B
	600V Both Line and Load Side Protective Module	43…480 A	
Auxiliary Contacts	1 N.O. auxiliary contact	for 3…480 A units	-90
	2 N.O. auxiliary contacts	for 3…480 A units	-900
	1 N.O. and 1 N.C. auxiliary contacts	for 3…480 A units	-901
Disconnect Auxiliary	N.O. disconnect auxiliary mounted on the operating mechanism		-98
	N.C. disconnect auxiliary mounted on the operating mechanism		-99
NEMA Bypass Contactor and Overload Relay	5…43 A		-NB
	60…85 A		
	108…135 A		
	201…251 A		
	317…361 A		
	480 A		
MCS Bypass Contactor and Overload Relay	5…43 A		-BP
	60…85 A		
	108…135 A		
	201…251 A		
	317…361 A		
	480 A		

Accessories

Auxiliary Contact Blocks

	Description	N.O.	N.C.	Connection Diagram	Cat. No.
	Auxiliary Contact Blocks for side mounting with sequence terminal designations 1- and 2-pole Quick and easy mounting without tools One block per device only	1	0		**150-CA10**
		2	0		**150-CA20**
		0	1		150-CA01
		1	1		**150-CA11** (Form C)

Fans

	Description		For Use With	Pkg. Qty.	Cat. No.
	Fan Field installed	Optional	150-C3…37	1	**150-CF64**
		Replacement	150-C43…85		**150-CF147**
			150-C108, 150-C135		**41391-801-03**
			150-C201, 150-C251		**41391-801-01**
			150-C317…C480		**41391-801-02**

Connecting Modules

	Description	For Use With	Pkg. Qty.	Cat. No.
	Connecting modules to 140-M Electrical interconnection between SMC-3 and 140-M. Motor protector and SMC must be mounted separately.	Connects 140-M-C to 150-C3…25	1	**150-CC25**
		Connects 140-M-D to 150-C3…25	1	**150-CD25**
		Connects 140-M-F to 150-C3…37	1	150-CF45
	Connecting modules to 100-C Electrical interconnection between SMC-3 and 100-C. Contactor and SMC must be mounted separately.	Connects 100-C09…23 to 150-C3…19	1	150-CI23
		Connects 100-C30…37 to 150-C3…37	1	150-CI37

Protective Modules

Protective modules must not be placed on the load side of a device when using an inside-the-delta connection.

Description		For Use With	Pkg. Qty.	Cat. No.
	480V Protective Module	150-C3…37NB	1	**150-C84**
		150-C43…85NB (line and/or load)	1	**150-C84P**
		150-C108…480NB (line and/or load)	1	**150-F84L**
	600V Protective Module	150-C3…37NC	1	150-C86
		150-C43…85NC (line and/or load)	1	150-C86P
		150-C108…480NC (line and/or load)	1	150-F86L

IEC Terminal Covers

Description		For Use With	Pkg. Qty.	Cat. No.
	Terminal Cover IEC line or load terminal covers for 108…480 A devices. Dead front protection	150-C108…-C135	1	**150-TC1**
		150-C201…-C251	1	**150-TC2**
		150-C317…-C480	1	**150-TC3**

Terminal Lug Kits (108…480 A)

Current Rating [A] ❄	Wire Size	Total No. of Line Controller Terminal Lugs Possible Each Side		Pkg. Qty.	Cat. No.
		Line Side	Load Side		
108…135♣	#6…250 MCM AWG 16 mm²…120 mm²	3	3	3	**199-LF1**
201…251♣		6	6		
317…480♣	#4…500 MCM AWG 25 mm²…240 mm²	6	6		**199-LG1**

Line and Load terminals are provided as standard on enclosed SMCs.

❄ 1…85 A units have box lugs standard. No additional lugs are required.

♣ When a multi-conductor lug is required, refer to the Instruction Sheet for appropriate lug catalog number.

Marking Tags and Covers

Description		For Use With	Pkg. Qty.	Cat. No.
	Marking Tag Sheet 160 perforated paper labels each, 6 x 17 mm, to be used with a transparent cover	150-C, 150-D	10	**100-FMP**
	Transparent Cover To be used with marking tag sheets	150-C, 150-D	100	**100-FMC**

Remote Reset Solenoid

Description		For Use With	Pkg. Qty.	Cat. No.
	Remote Reset Solenoid for remote reset of electronic overload	193-T all, 150-C	1	193-ER1⊗

⊗ Voltage Suffix Code

Voltage	24	48	110	115	120	220	240
50 Hz	J	—	D	—	—	A	—
60 Hz	J	—	—	—	D	—	A
DC	Z24	Z48	—	Z01	—	—	—

Surcharge for special voltages up to 20 pcs. (no surcharge for quantities greater than 20 pcs.)

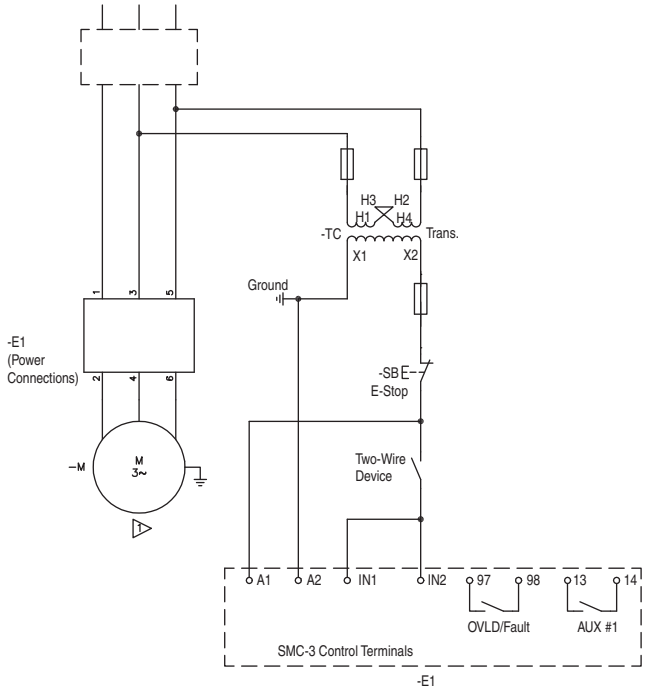
Available Coil Voltages 12…600V 50 Hz/12…600V 60 Hz

Standard Coil Voltages

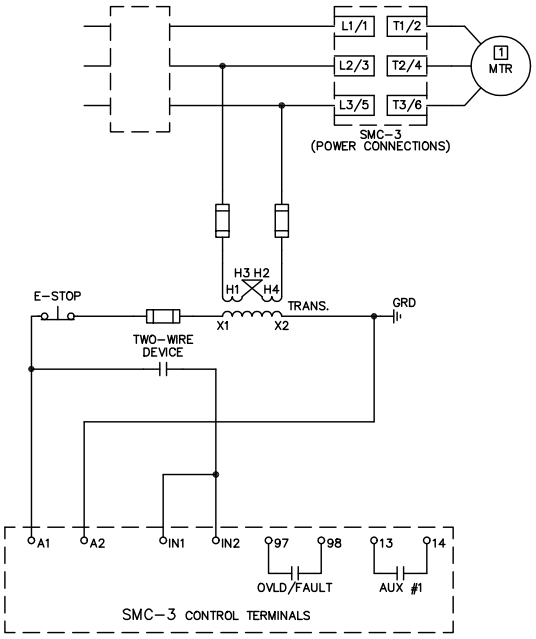
4

Two-Wire Configuration

IEC

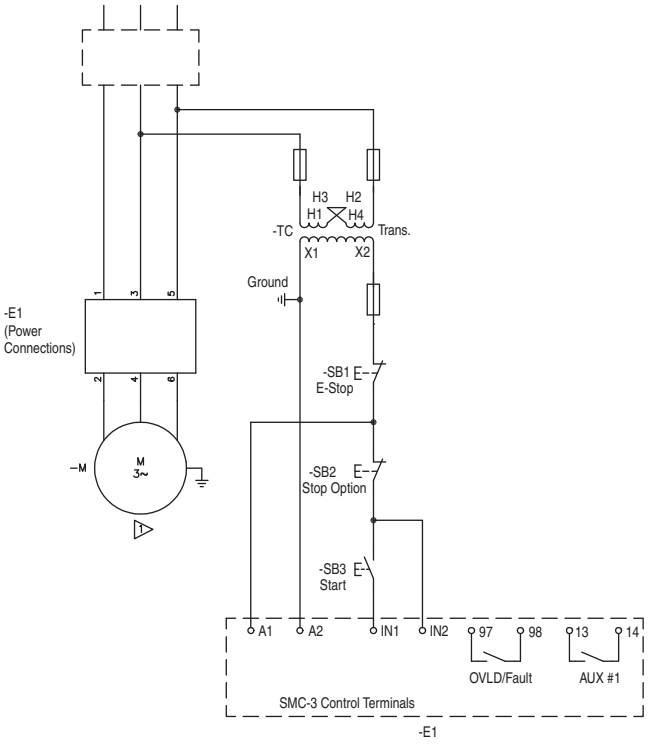


NEMA



Three-Wire Configuration

IEC



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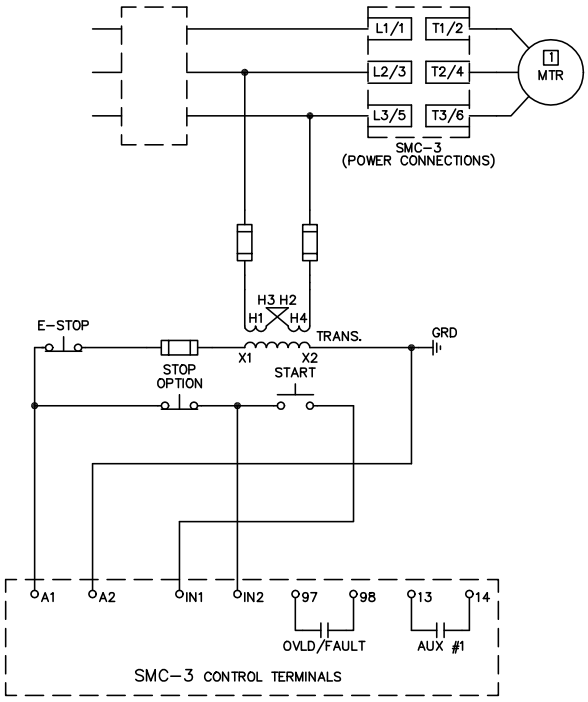
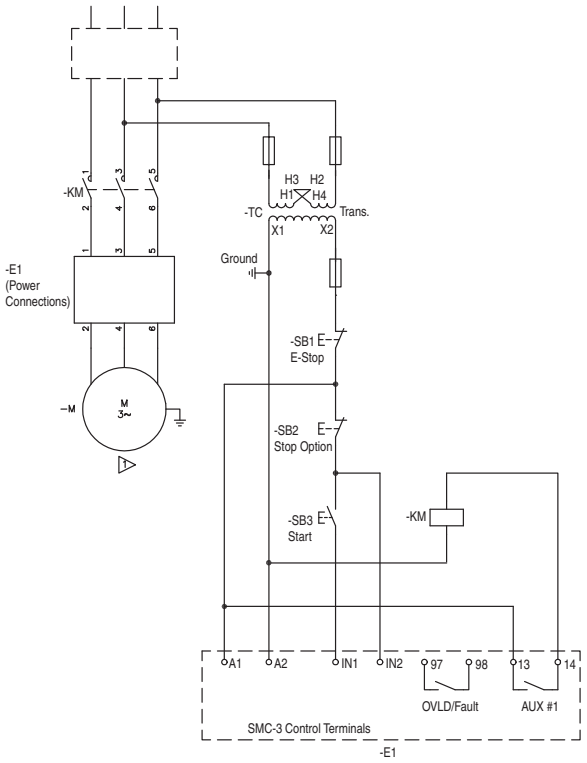
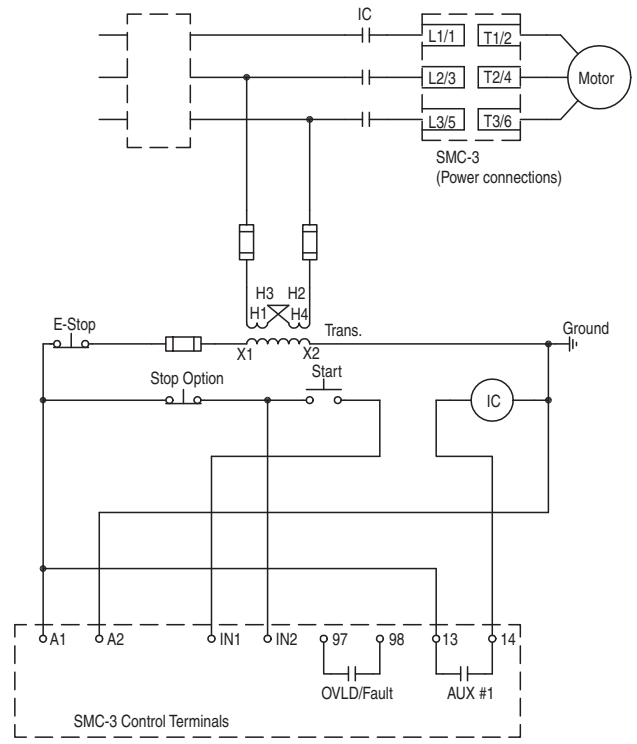


Isolation Contactor Configuration

IEC



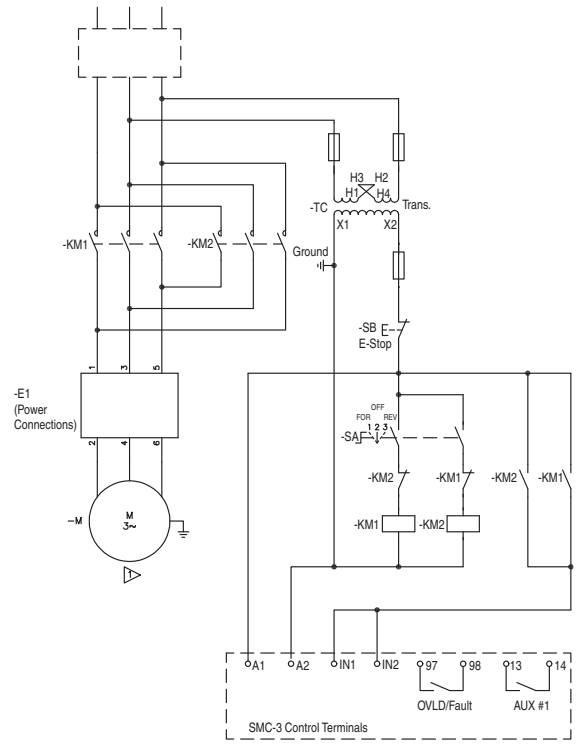
NEMA



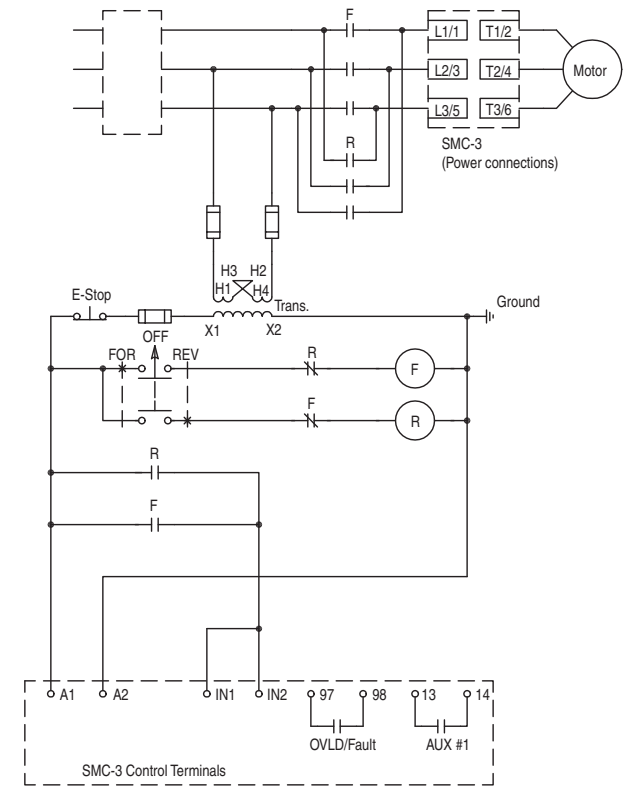
Reversing Configuration

Note: Minimum Off time equals 1.0 s.

IEC



NEMA



Standard Features							
Selectable Start Times			2, 5, 10, 15, 20, 25, or 30 s				
Selectable Initial Torque			0%, 25%, 35%, and 65% of locked rotor torque				
Selectable Current Limit			150%, 250%, 350%, and 450% of full load current				
Selectable Kick Start — 450% FLA			0, 0.5, 1.0, or 1.5 s				
Selectable Soft Stop			Off, 100%, 200%, or 300% of the start time setting when wired				
Electrical Ratings							
			UL/CSA/NEMA			**IEC**	
Power Circuit	Rated Operation Voltage		200…480V AC 200…600V AC			200…480V~ — 400V~ 500V~ — 500V~	
	Rated Insulation Voltage		600V AC			500V~	
	Dielectric Withstand		2200V AC			2500V~	
	Repetitive Peak		200…480V AC: 1400V 200…600V AC: 1600V			200…480V~: 1400V 500V~: 1600V	
	Operating Frequency		50/60 Hz			50/60 Hz	
	Utilization Category	1…37 A	—			AC-53b: 3.5-15:3585	
		43…60 A	—			AC-53b: 4.5-30:1770	
		85 A	—			AC-53b: 4.5-30:3570	
		108 A	—			AC-53b: 4.5-30:1770	
		135 A	—			AC-53b: 3.5-30: 1770	
		201…251 A	—			AC-53b: 3.5-30: 1770	
		317…480 A	—			AC-53b: 3.5-30: 1770	
	Number of Poles		Equipment designed for 3-phase only				
	Rated Impulse Voltage		6 kV				
	DV/DT Protection		1000V/µs				
	Overvoltage Category		III				
Short Circuit Protection	SCPD Performance		Type 1§♣				
			Non-Time Delay		Thermal Magnetic Circuit Breaker		High Capacity Time Delay Class CC/J/L	
	SCPD List‡		Max. Standard Available Fault	Max. Standard Fuse [A]❄	Max. Standard Available Fault	Max. Circuit Breaker [A]	Max. Standard Available Fault	Max. Fuse [A]
	Line Device Operational Current Rating [A]	3	5 kA	12	5 kA	15	70 kA	6
		9	5 kA	30	5 kA	30	70 kA	15
		16	5 kA	60	5 kA	60	70 kA	30
		19	5 kA	70	5 kA	70	70 kA	40
		25	5 kA	100	5 kA	100	70 kA	50
		30	10 kA	110	10 kA	110	70 kA	60
		37	10 kA	125	10 kA	125	70 kA	60
		43	10 kA	150	10 kA	150	70 kA	90
		60	10 kA	225	10 kA	225	70 kA	125
		85	10 kA	300	10 kA	300	70 kA	175
		108	10 kA	400	10 kA	300	70 kA	200
		135	10 kA	500	10 kA	400	70 kA	250
		201	18 kA	600	18 kA	600	70 kA	350
		251	18 kA	700	18 kA	700	70 kA	400
		317	30 kA	800	30 kA	800	69 kA	500
		361	30 kA	1000	30 kA	1000	69 kA	600
		480	42 kA	1200	42 kA	1200	69 kA	800
	Delta Device Operational Current Rating [A]	5.1	5 kA	15	5 kA	15	70 kA	10
		16	5 kA	60	5 kA	60	70 kA	30
		27.6	5 kA	70	5 kA	70	70 kA	60
		32.8	5 kA	125	5 kA	125	70 kA	70
		43	5 kA	150	5 kA	150	70 kA	90
		52	10 kA	200	10 kA	200	70 kA	100
		64	10 kA	250	10 kA	250	70 kA	100
		74	10 kA	250	10 kA	250	70 kA	150
		104	10 kA	400	10 kA	300	70 kA	225
		147	10 kA	400	10 kA	400	70 kA	300
		187	10 kA	600	10 kA	500	70 kA	400
		234	10 kA	700	10 kA	700	70 kA	400
		348	18 kA	1000	18 kA	1000	70 kA	600
		435	18 kA	1200	18 kA	1200	69 kA	800
		549	30 kA	1600	30 kA	1600	69 kA	1000
		625	30 kA	1600	30 kA	1600	69 kA	1200
		831	42 kA	1600	30 kA	1600	69 kA	1600
		831	42 kA	1600	42 kA	1200	69 kA	1600

❄ Non-time delay fuses (K5).

‡ Consult local codes for proper sizing of short-circuit protection.

§ Type 1 performance/protection indicates that, under a short-circuit condition, the fused or circuit breaker-protected starter shall cause no danger to persons or installation but may not be suitable for further service without repair or replacement.

Electrical Ratings				
			UL/CSA/NEMA	IEC
Control Circuit	Rated Operational Voltage (+10%, –15%)		100…240V AC, 24V AC/DC	100…240V~, 24V AC/DC
	Rated Insulation Voltage		250V	250V~
	Rated Impulse Voltage		2.5 kV	4 kV
	Dielectric Withstand		1500V AC	2000V~
	Overvoltage Category		II	III∗
	Operating Frequency		50/60 Hz	50/60 Hz
	Input onstate voltage minimum, during start (IN1, IN2)		85V AC, 19.2V DC / 19.2V AC	
	Input onstate current (IN1, IN2)		9.8 mA @120V AC/19.6 mA @ 240V AC, 7.3 mA @ 24V AC/DC	
	Input offstate voltage maximum (IN1, IN2)		40V AC, 17V DC / 12V AC	
	Input offstate current @ input offstate voltage (IN1, IN2)		<10 mA, <12 mA	
	Control Power with Fan, during start	3…37 A	215 mA @ 120V AC / 180 mA @ 240V AC, 800 mA @ 24V DC / 660 mA @ 24V AC	
		43…85 A	200 mA @ 120V AC / 100 mA @ 240V AC, 700 mA @ 24V AC/DC	
			Fan Power	**Control Power**
		108…135 A	20VA	200 mA @ 120V AC / 120 mA @ 240V AC, 600 mA @ 24V AC/DC
		201…251 A	40VA	
		317…480 A	60VA	
	Control Power without Fan, during start	3…37 A	205 mA @ 120V AC / 145 mA @ 240V AC, 705 mA @ 24V DC / 580 mA @ 24V AC	

Steady State Heat Dissipation and Overload Current Range			
	Controller Rating [A]	Steady State Heat Dissipation [W]	Overload Current Range [A]
	3	11	1…3
	9	12	3…9
	16	14	5.3…16
	19	15	6.3…19
	25	17	9.2…27.7
	30	19	10…30
	37	24	12.3…37
	43	34	14.3…43
	60	50	20…60
	85	82	28.3…85
	108	62	27…108
	135	75	34…135
	201	129	67…201
	251	147	84…251
	317	174	106…317
	361	194	120…361
	480	239	160…480

Auxiliary Contacts			
		UL/CSA/NEMA	IEC
Rated Operational Voltage		250V AC/30V DC	250V~/30V DC
Rated Insulation Voltage		250V	250V~
Rated Impulse Voltage		2.5 kV	4 kV
Dielectric Withstand		1500V AC	2000V~
Overvoltage Category		II	III∗
Operating Frequency		50/60 Hz	50/60 Hz
Utilization Category		D300/D300	AC-15/DC
TB-97, -98 (OVLD/Fault)	Type of Control Circuit	Electromagnetic relay	
	Number of Contacts	1	
	Type of Contacts	Normally Open (N.O.)	
	Type of Current	AC/DC	
	Rated Operational Current (max.)	0.6 A @ 120V~ and 0.3 A @ 240V~	
	Conventional Thermal Current I_{th}	1 A	
	Make/Break VA	432/72	
TB-13, -14 Aux 1 (Normal/Up-to-Speed)	Type of Control Circuit	Electromagnetic relay	
	Number of Contacts	1	
	Type of Contacts	Normally Open (N.O.)	
	Type of Current	AC/DC	
	Rated Operational Current (max.)	0.6 A @ 120V~ and 0.3 A @ 240V~	
	Conventional Thermal Current I_{th}	1 A	
	Make/Break VA	432/72	

∗ Overvoltage category II, when either control or auxiliary circuit is wired to a SELV or PELV circuit.

Electrical Ratings			
Side-Mount Auxiliary Contacts			
		UL/CSA/NEMA	IEC
Rated Operational Voltage		250V AC/30V DC	250V AC/30V DC
Rated Insulation Voltage		250V	250V AC
Rated Impulse Voltage		2.5 kV	4 kV
Dielectric Withstand		1500V AC	2000V AC
Overvoltage Category		II	III*
Operating Frequency		50/60 Hz	50/60 Hz
TB-23, -24 (Normal/Up-to-Speed) TB-33, -34 (Normal/Up-to-Speed)	Utilization Category	C300/R150	AC-15/DC-13
	Type of Control Circuit	Electromagnetic relay	
	Number of Contacts	1	
	Type of Contacts	Normally Open (N.O.)	
	Type of Current	AC/DC	
	Rated Operational Current (max.)	1.5 A @ 120V AC, 0.75A @ 240V AC, 1.17 A @ 24V DC	
	Conventional Thermal Current I_{th}	2.5 A	
	Make/Break VA	1800/180V AC, 28V DC (resistive)	
TB-11, -12 (Normal/Up-to-Speed)	Type of Control Circuit	B300/R300	AC-15/DC-13
	Type of Control Circuit	Electromagnetic relay	
	Number of Contacts	1	
	Type of Contacts	Normally Closed (N.C.)	
	Type of Current	AC/DC	
	Rated Operational Current (max.)	3 A @ 120V AC, 1.5A @ 240V AC, 1.17 A @ 24V DC	
	Conventional Thermal Current I_{th}	5 A	
	Make/Break VA	3600/360VA, 28VA (DC resistive)	

* Overvoltage category II, when either control or auxiliary circuit is wired to a SELV or PELV circuit.

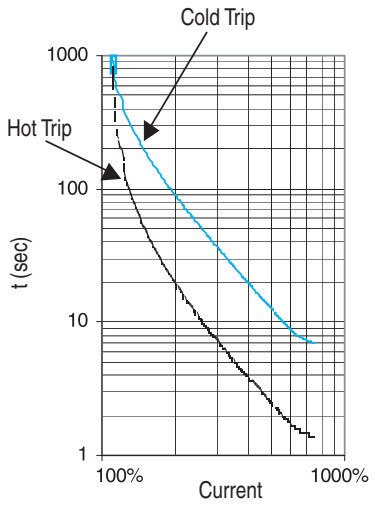
Environmental	
Operating Temperature Range	-5…+50 °C (23…122 °F) (open) -5…+40 °C (23…104 °F) (enclosed)
Storage and Transportation Temperature Range	-25…+85 °C (-13…+185 °F)
Altitude	2000 m (6560 ft)
Humidity	5…95% (non-condensing)
Pollution Degree	2
Type of Protection	IP2X

Mechanical Ratings			
Resistance to Vibration	Operational		1.0 G Peak, 0.15 mm (0.006 in.) displacement
	Non-Operational		2.5 G Peak, 0.38 mm (0.015 in.) displacement
Resistance to Shock	Operational		15 G
	Non-Operational		30 G
Line Power Terminals	Cable Size Tightening Torque	3…37 A	2.5…25 mm2 (14…4 AWG) 2.3…2.8 N•m (20…25 in•lbs)
		43…85 A	2.5…95 mm2 (14…3/0 AWG) 11.3…12.4 N•m (100…110 in•lbs)
		108…135 A	23 N•m (200 in•lbs)
		201…251 A	Two M10 x 1.5 diameter holes per power pole
		317…480 A	Two M12 x 1.75 diameter holes per power pole
Load Power Terminals	Cable Size Tightening Torque	3…37 A	2.5…16 mm2 (14…6 AWG) 2.3…2.5 N•m (20…22.5 in•lbs)
		43…85 A	2.5…50 mm2 (14…1 AWG) 11.3…12.4 N•m (100…110 in•lbs)
		108…135 A	23 N•m (200 in•lbs)
		201…251 A	Two M10 x 1.5 diameter holes per power pole
		317…480 A	Two M12 x 1.75 diameter holes per power pole
Control Terminals	Cable Size Tightening Torque	All	0.2…2.5 mm2 (24…14 AWG) 0.5…0.9 N•m (4.4…8.0 in•lbs)

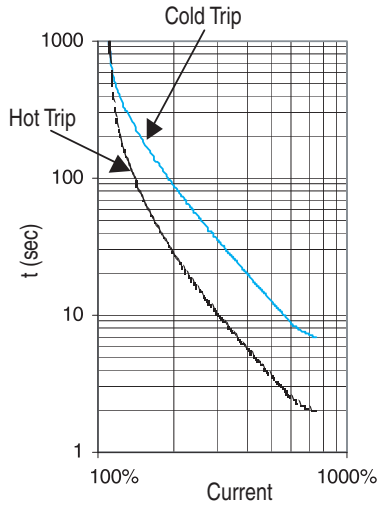
Other			
		UL/CSA/NEMA	IEC
EMC Emission Levels	Conducted Radio Frequency Emissions	—	Class A
	Radiated Emissions	—	Class A
EMC Immunity Levels	Electrostatic Discharge	4 kV Contact and 8 kV Air Discharge	8 kV Air Discharge
	Radio Frequency Electromagnetic Field	—	Per EN/IEC 60947-4-2
	Fast Transient	—	Per EN/IEC 60947-4-2
	Surge Transient	—	Per EN/IEC 60947-4-2

SMC-3 Overload Trip Curves

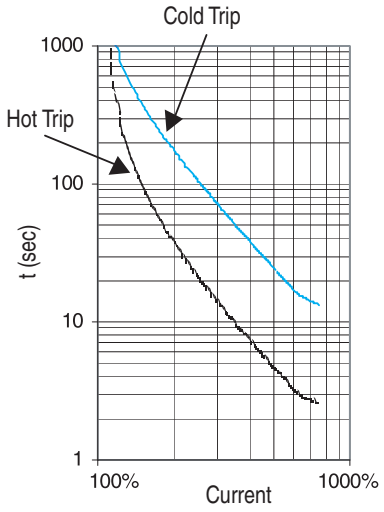
Trip Class 10



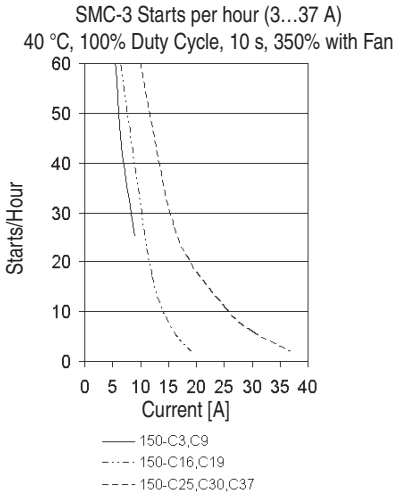
Trip Class 15

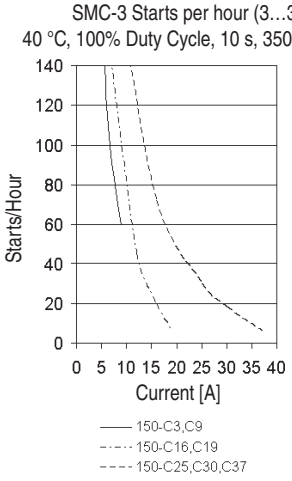


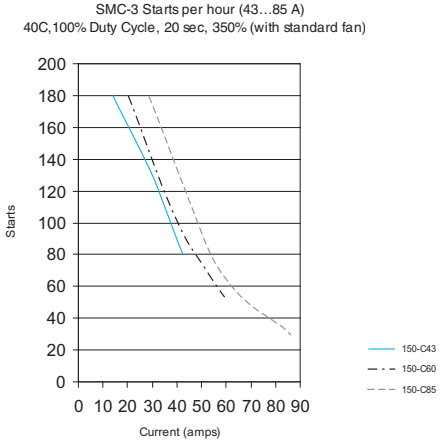
Trip Class 20

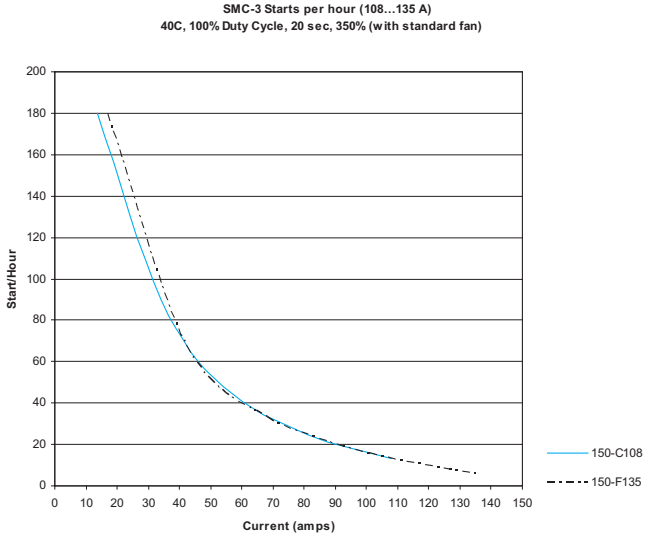


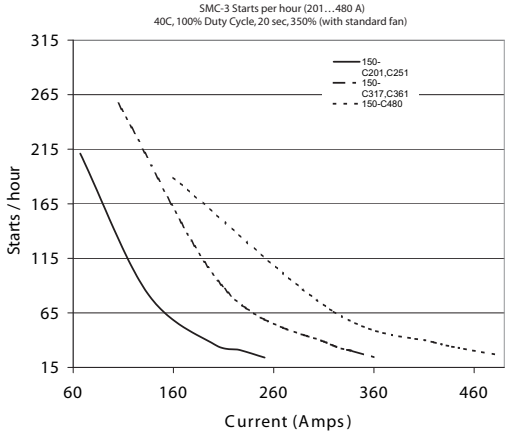
Starts per Hour Curves





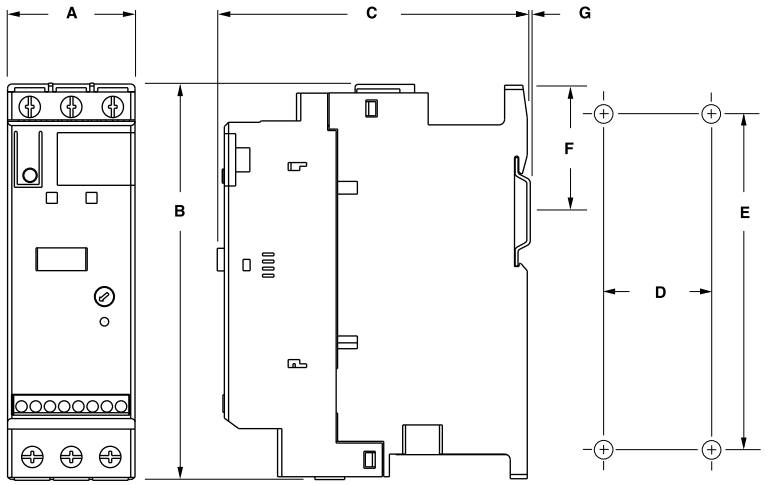






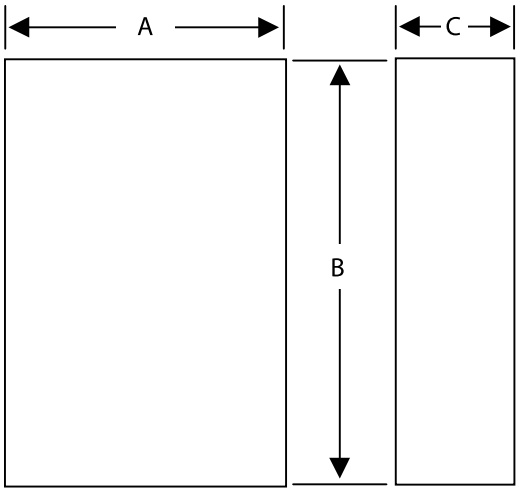
Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.

Open Type



Controller Rating [A]	A	B	C	D	E	F	G	Mounting Hole Size	Weight kg (lbs)
1…37	44.8 (1-49/64)	139.7 (5-1/2)	100 (4-21/64)	35 (1-3/8)	132 (5-13/64)	46.4 (1.81)	2 (1/16)	4.6 (0.18)	0.86 (1.9)
43…85	72 (2.83)	206 (8.11)	130 (5.12)	55 (2.17)	198 (7.8)	102 (4.02)	2 (1/16)	5.3 (0.21)	2.25 (5.0)
108…135	196.4 (7.74)	443.7 (17.47)	205.2 (8.08)	166.6 (6.56)	367 (14.45)	—	—	7.5 (0.295)	15 (33)
201…251	225 (8.86)	560 (22.05)	265.3 (10.45)	150 (5.91)	504.1 (19.85)	—	—	11.5 (0.45)	30.4 (67)
317…480	290 (11.42)	600 (23.62)	298 (11.73)	200 (7.87)	539.2 (21.23)	—	—	11.5 (0.45)	45.8 (101)

Minimum Enclosure Size



Controller Rating [A]	B Height	A Width	C Depth	Fan Requirements
1…37 A	305 (12)	224 (9)	152 (6)	none
43…85 A	406 (16)	305 (12)	203 (8)	none
108…135 A	762 (30)	610 (24)	305 (12)	none
201…251 A	965 (38)	762 (30)	356 (14)	none
317…480 A	1295 (51)	914 (36)	356 (14)	none

Enclosed Type Line-Connected Controllers

Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.

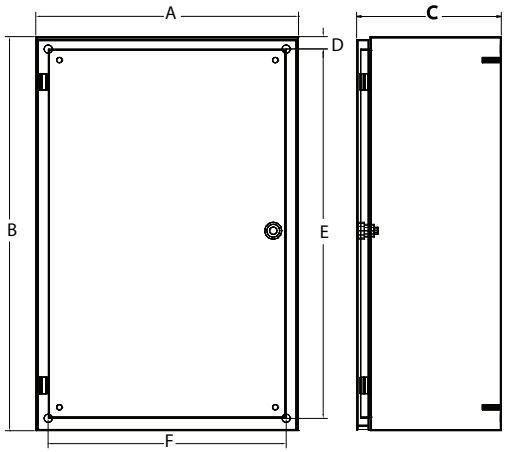


Figure 1 — Wall-Mount

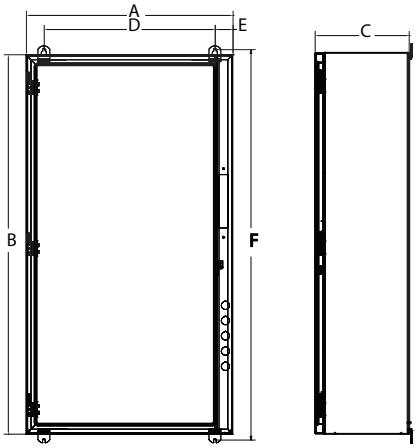


Figure 2 — Wall-Mount

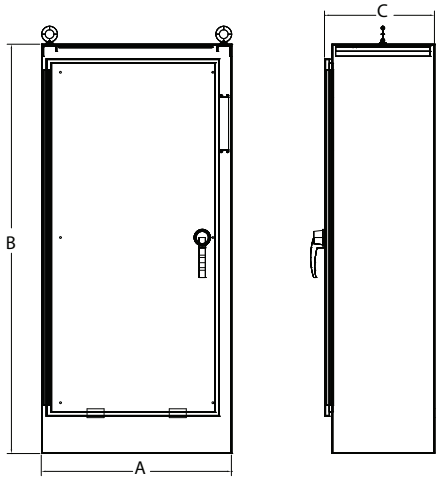


Figure 3 — Floor-Mount

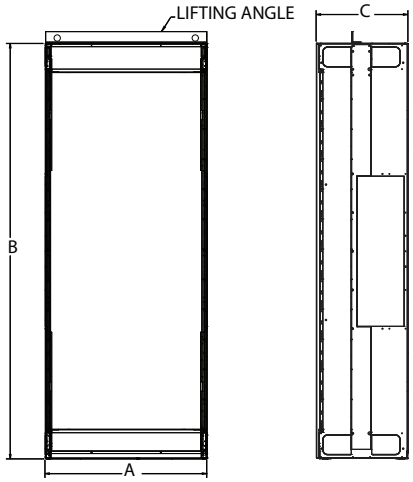


Figure 4 — Floor-Mount

Controller Rating [A]	Bulletin	With Option	Dimension Figure No.	Dimensions in inches (mm)					
				A (Width)	B (Height)	C (Depth)	D (Mtg. Dim.)	E (Mtg. Dim.)	F (Mtg. Dim.)
SMC-3 Non-Combination Controller									
3…37	150	—	1	8 (203)	12 (305)	6 (152)	2.44 (62)	10.43 (265)	3.0 (76)
		6P		12 (305)	12 (305)	6 (152)	2.41 (61)	10.43 (265)	7.0 (178)
43…85	150	—	1	8 (203)	14 (356)	8 (203)	2.44 (62)	12.40 (315)	3.0 (76)
				16 (406)	14 (356)	8 (203)	4.38 (111)	12.40 (315)	7.0 (178)
108…135	150	Any	1	24 (610)	30 (762)	12 (305)	0.75 (19)	28.5 (724)	22.5 (572)
201…251	150	—	1	30 (762)	38 (965)	14 (356)	0.75 (19)	36.5 (927)	28.5 (724)
	150, 150B	BP,NB,NI,6P		36 (914)	51 (1295)	14 (356)	0.75 (19)	49.5 (1257)	34.5 (876)
317…361	150	Any	1	36 (914)	51 (1295)	14 (356)	0.75 (19)	49.5 (1257)	34.5 (876)
	150B	—		36 (914)	51 (1295)	14 (356)	0.75 (19)	49.5 (1257)	34.5 (876)
		NI, 6P		36 (914)	51 (1295)	14 (356)	0.75 (19)	49.5 (1257)	34.5 (876)
		BP,NI, 6P		36 (914)	60 (1524)	14 (356)	0.75 (19)	58.5 (1486)	34.5 (876)
480	150	—	1	36 (914)	51 (1295)	14 (356)	0.75 (19)	49.5 (1257)	34.5 (876)
	150, 150B	BP,NB,NI,6P		36 (914)	60 (1524)	14 (356)	0.75 (19)	58.5 (1486)	34.5 (876)

Controller Rating [A]	Bulletin	With Option	Dimension Figure No.	Dimensions in inches (mm)					
				A (Width)	B (Height)	C (Depth)	D (Mtg. Dim.)	E (Mtg. Dim.)	F (Mtg. Dim.)
SMC-3 Combination Controller									
3…37	152H,153H	Any	1	16 (406)	14 (356)	8 (203)	4.38 (111)	12.40 (315)	7.0 (178)
43	152H	Any	1	16 (406)	14 (356)	8 (203)	4.38 (111)	12.40 (315)	7.0 (178)
	153H	Any	1	16 (406)	24 (610)	10 (254)	0.75 (19)	22.5 (572)	14.5 (368)
60	152H, 153H	Any	1	16 (406)	24 (610)	9 (229)	0.75 (19)	22.5 (572)	14.5 (368)
	152H	Any	1	24 (610)	30 (762)	12 (305)	0.75 (19)	28.5 (724)	22.5 (572)
85	152H	Any	1∗	16 (406)	24 (610)	9 (229)	0.75 (19)	22.5 (572)	14.5 (368)
		Any	1❄	24 (610)	30 (762)	12 (305)	0.75 (19)	28.5 (724)	22.5 (572)
	153H	Any	1	16 (406)	24 (610)	9 (229)	0.75 (19)	22.5 (572)	14.5 (368)
108	152H,153H	Any	1	30 (762)	38 (965)	14 (356)	0.75 (19)	36.5 (927)	28.5 (724)
	152B,153B	Any	1	36 (914)	51 (1295)	14 (356)	0.75 (19)	49.5 (1257)	34.5 (876)
135	152H,153H	Any	1	30 (762)	38 (965)	14 (356)	0.75 (19)	36.5 (927)	28.5 (724)
	152B,153B	Any	1	36 (914)	51 (1295)	14 (356)	0.75 (19)	49.5 (1257)	34.5 (876)
201	152H,153H	—	1	30 (762)	38 (965)	14 (356)	0.75 (19)	36.5 (927)	28.5 (724)
	152B,153B, 152H,153H	Any	1	36 (914)	51 (1295)	14 (356)	0.75 (19)	49.5 (1257)	34.5 (876)
251	152H,153H	—	1	30 (762)	38 (965)	14 (356)	0.75 (19)	36.5 (927)	28.5 (724)
	152B,153B, 152H,153H	Any	1	36 (914)	51 (1295)	14 (356)	0.75 (19)	49.5 (1257)	34.5 (876)
317	153H	—	1	36 (914)	51 (1295)	14 (356)	0.75 (19)	49.5 (1257)	34.5 (876)
		BP,NB	1	36 (914)	60 (1524)	14 (356)	0.75 (19)	58.5 (1486)	34.5 (876)
	153B	—	1	36 (914)	60 (1524)	14 (356)	0.75 (19)	58.5 (1486)	34.5 (876)
	152B,152H	—	2	38 (965)	60 (1524)	17 (431)	33.88 (861)	1.75 (45)	61.69 (1567)
	152H	BP	2	38 (965)	60 (1524)	17 (431)	33.88 (861)	1.75 (45)	61.69 (1567)
	152B,152H,153B,153H	NB,NI	3	40 (1016)	84 (2134)	18 (457)	—	—	—
361	153H	—	1	36 (914)	51 (1295)	14 (356)	0.75 (19)	49.5 (1257)	34.5 (876)
		BP,NB	1	36 (914)	60 (1524)	14 (356)	0.75 (19)	58.5 (1486)	34.5 (876)
	153B	—	1	36 (914)	60 (1524)	14 (356)	0.75 (19)	58.5 (1486)	34.5 (876)
	152B,152H	—	2	38 (965)	60 (1524)	17 (431)	33.88 (861)	1.75 (45)	61.69 (1567)
	152H	BP	2	38 (965)	60 (1524)	17 (431)	33.88 (861)	1.75 (45)	61.69 (1567)
	152B,152H,153B,153H	NB,NI	3	40 (1016)	84 (2134)	18 (457)	—	—	—
480	153H	—	1	36 (914)	51 (1295)	14 (356)	0.75 (19)	49.5 (1257)	34.5 (876)
		BP	3§	40 (1016)	84 (2134)	18 (457)	—	—	—
	152H,153B	Any	3	40 (1016)	84 (2134)	18 (457)	—	—	—
	152H	—	4§	20 (508)	91.5 (2324)	20 (508)	—	—	—
	152B, 152H	BP,NB	4§	35 (889)	91.5 (2324)	20 (508)	—	—	—

∗ Rating 20 Hp @208V, 25 Hp @240V, 50 Hp @ 480V, 60 Hp @ 600V
❄ Rating 25 Hp @208V, 30 Hp @240V, 60 Hp @ 480V, 75 Hp @ 600V
§ 200 Hp @ 240V AC, 400 Hp @480V, 500 Hp @ 600V

Bulletin 150 — SMC™ Dialog Plus Smart Motor Controller

The SMC™ Dialog Plus controller provides microprocessor controlled starting for standard three-phase squirrel-cage induction motors. Four standard modes of operation are available within a single controller:

- Soft Start with Selectable Kickstart
- Current Limit Start with Selectable Kickstart
- Dual Ramp Start
- Full Voltage Start

Options include:

- Soft Stop
- Pump Control
- Preset Slow Speed
- SMB Smart Motor Braking
- Accu-Stop
- Slow Speed with Braking

Features include:

- Built-in electronic motor overload protection
- Metering
- SCANport communication
- Keypad programming
- Three programmable auxiliary contacts
- LCD display

The SMC™ Dialog Plus controller is available for motors rated 1…1000 A; 200…480V AC, or 200…600V AC, 50 and 60 Hz. In addition to motors, the SMC Dialog Plus™ controller can be used to control resistive loads.

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Standards Compliance

UL 508
CSA C22.2 No.14
EN/IEC 60947-1
EN/IEC 60947-4-2

Certifications

cULus Listed (Open Type) (File No. E96956, Guides NMFT, NMFT7)
CSA Certified (File No. LR 1234)
CE Marked (Open Type) per EMC and Low Voltage Directive
CCC Certified

Description of Features

Electronic Motor Overload Protection

The SMC Dialog Plus controller incorporates, as standard, electronic motor overload protection. This overload protection is accomplished electronically with an I^2t algorithm.
When coordinated with the proper short circuit protection, overload protection is intended to protect the motor, motor controller, and power wiring against overheating caused by excessive overcurrent. The SMC Dialog Plus controller meets applicable requirements as a motor overload protective device.
The controller's overload protection is programmable, providing the user with flexibility. The overload trip class can be selected for class 10, 15, 20, or 30 protection. The trip current is programmed by entering the motor full-load current rating.
Thermal memory is included to accurately model motor operating temperature. Ambient insensitivity is inherent in the electronic design of the overload.
Note: The current sensing capability of the SMC Dialog Plus controller is disabled during bypass operation. The Bulletin 825 Converter Module and 150-NFS fanning strip are required for providing current feedback in these applications. **Note:** To achieve calibration, 70% motor load or greater is required at the motor shaft for 2 s. Calibration is required when a Bulletin 825 Converter Module is not used.

Stall Protection and Jam Detection

Motors can experience locked rotor currents and develop high torque levels in the event of a stall or a jam. These conditions can result in winding insulation breakdown or mechanical damage to the connected load. The SMC Dialog Plus controller provides both stall protection and jam detection for enhanced motor and system protection. Stall protection allows the user to program a maximum stall protection delay time from 0…10 s. The stall protection delay time is in addition to the programmed start time and begins only after the start time has timed out. If the controller senses that the motor is stalled, it will shut down after the delay period has expired. Jam detection allows the user to determine the motor jam detection level as a percentage of the motor's full load current rating. To prevent nuisance tripping, a jam detection delay time, from 0.0…10.0 s, can be programmed. This allows the user to select the time delay required before the SMC Dialog Plus controller will trip on a motor jam condition. The motor current must remain above the jam detection level during the delay time. Jam detection is active only after the motor has reached full speed.

Energy Saver

This is a standard feature with the SMC Dialog Plus controller. It is used to save energy on applications where the motor is lightly loaded or unloaded for long periods of time. The Energy Saver is a built-in feature of the controller. It does not require additional panel space or external wiring. It also does not require a complicated setup procedure.

Phase Rebalance

The SMC Dialog Plus controller incorporates, as standard, a dynamic Phase Rebalance feature. The controller compensates for voltage unbalance by automatically adjusting the voltage output to balance the 3-phase currents drawn by the motor. When phase rebalance is achieved, motor life may be extended and production can continue without interruption. Phase Rebalance is a built-in feature of the controller and does not require a complicated setup procedure.
Note: Phase Rebalance requires the use of the Bulletin 825 Converter Module and the Cat. No. 150-NFS fanning strip.
Note: The performance of the Phase Rebalance feature is dependent on the motor's loading and characteristics. Severe imbalances cannot be corrected.

Underload Protection

Utilizing the underload protection of the SMC Dialog Plus controller, motor operation can be halted if a drop in current is sensed.
The SMC Dialog Plus controller provides an adjustable underload trip setting from 0…99% of the programmed motor full load current rating with an adjustable trip delay time of 0…99 s.

Undervoltage Protection

The SMC Dialog Plus controller's undervoltage protection will halt motor operation if a drop in the incoming line voltage is detected. The undervoltage trip level is adjustable as a percentage of the programmed line voltage, from 0…99%. To eliminate nuisance trips, a programmable undervoltage trip delay time of 0…99 s can also be programmed. The line voltage must remain below the undervoltage trip level during the programmed delay time.

Overvoltage Protection

If a rise in the incoming line voltage is detected, the SMC Dialog Plus controller's overvoltage protection will halt motor operation. The overvoltage trip level is adjustable as a percentage of the programmed line voltage, from 0…99%. To eliminate nuisance trips, a programmable overvoltage trip delay time of 0…99 s can also be programmed. The line voltage must remain above the overvoltage trip level during the programmed delay time.

Voltage Unbalance Protection

Voltage unbalance is detected by monitoring the 3-phase supply voltage magnitudes in conjunction with the rotational relationship of the three phases. The controller will halt motor operation when the calculated voltage unbalance reaches the user-programmed trip level.
The voltage unbalance trip level is programmable from 0…25% unbalance.

Excessive Starts Per Hour

The SMC Dialog Plus controller allows the user to program the allowed number of starts per hour (up to 99). This helps eliminate motor stress caused by repeated starting during a short time period.

Metering

Power monitoring parameters include:

- 3-phase current
- 3-phase voltage
- Power in kW
- Power usage in kWH
- Power factor
- Motor thermal capacity usage
- Elapsed time

Note: The motor thermal capacity usage allows the user to monitor the amount of overload thermal capacity usage before the SMC Dialog Plus controller's built-in electronic overload trips.
Note: In bypass configurations, the current sensing and power factor measurement capability of the SMC Dialog Plus controller is disabled. Three-phase current measurement, kW, kWH, and motor thermal capacity usage can still be maintained with the use of the Bulletin 825 Converter Module.
Note: The usage of an SMC Controller on a generator and line power requires the use of a Bulletin 825 Converter Module.

Built-in SCANport™ Communication

A serial interface port is provided as standard, which allows connection to a Bulletin 1201 Human Interface Module or a variety of Bulletin 1203 Communication Modules. This includes Allen-Bradley Remote I/O, DeviceNet network and RS-232/422/485-DF1.

LCD Display

The SMC Dialog Plus controller's two-line 16-character backlit LCD display provides parameter identification using clear, informative text. Controller set up can be performed quickly and easily without the use of a reference manual. Parameters are arranged in an organized four-level menu structure for ease of programming and fast access to parameters.

Keypad Programming

Programming of parameters is accomplished through a five-button keypad on the front of the SMC Dialog Plus controller. The five buttons include up and down arrows, an Enter button, a Select button, and an Escape button. The user needs only to enter the correct sequence of keystrokes for programming the SMC Dialog Plus controller.

Auxiliary Contacts

Three hard contacts are furnished as standard with the SMC Dialog Plus controller. The first two contacts are programmable for Normal/Up-to-speed. The third is programmable for Normal/Fault.

Open Controllers

150 – B180 N B D A – 8L
a *b* *c* *d* *e* *f* *g*

a

Bulletin Number	
Code	Description
150	Solid-State Controller
150B 152H 153H	Solid-State Controller and Isolation Contactor (enclosed only)❄

b

Controller Ratings	
Code	Description
B24	24 A, 1…15 Hp @ 460V AC
B35	35 A, 1…25 Hp @ 460V AC
B54	54 A, 1…40 Hp @ 460V AC
B97	97 A, 5…75 Hp @ 460V AC
B135	135 A, 5…100 Hp @ 460V AC
B180	180 A, 5…150 Hp @ 460V AC
B240	240 A, 5…200 Hp @ 460V AC
B360	360 A, 5…300 Hp @ 460V AC
B500	500 A, 4…400 Hp @ 460V AC
B650	650 A, 5…500 Hp @ 460V AC
B720	720 A, 5…600 Hp @ 460V AC
B850	850 A, 10…700 Hp @ 460V AC
B1000	1000 A, 10…800 Hp @ 460V AC

❄ For enclosed products, visit www.ab.com/catalogs.

c

Enclosure Type	
Code	Description
N	Open

d

Input Line Voltage	
Open Type	
Code	Description
B	200…460V AC, 3-phase, 50 and 60 Hz
C	200…575V AC, 3-phase, 50 and 60 Hz

f

Control Options (see page 4-162 for a full listing.)	
Note: Select Only One	
Code	Description
Blank	Standard
A	Soft Stop
B	Pump Control
C	Preset Slow Speed
D	SMB Smart Motor Braking
E	Accu-Stop
F	Slow Speed with Braking

g

Options	
Code	Description
8L	Line-Mounted Protective Module
8M	Load-Mounted Protective Module
8B	Line- and Load-Mounted Protective Modules

4

Open Type Controllers

Up to 460V AC

Current∗ Rating [A]	kW❄ 230V AC 50 Hz	kW❄ 400V AC 50 Hz	Hp‡ 200V AC 60 Hz	Hp‡ 230V AC 60 Hz	Hp‡ 460V AC 60 Hz	100…240V AC 50/60 Hz Control Cat. No.	24V AC/DC Control Cat. No.
24	5.5	11	1…5	1…7.5	1…15	**150-B24NBD**	150-B24NBR
35	10	18.5	1…10	1…10	1…25	150-B35NBD	150-B35NBR
54	15	22	1…15	1…20	1…40	**150-B54NBD**	150-B54NBR
97	25	45	5…30	5…30	5…75	**150-B97NBD** §	150-B97NBR
135	37	75	5…40	5…50	5…100	**150-B135NBD** §	150-B135NBR
180	51	90	5…60	5…60	5…150	**150-B180NBD** §	150-B180NBR
240	75	132	5…75	5…75	5…200	**150-B240NBD** §	150-B240NBR
360	110	200	5…125	5…150	5…300	**150-B360NBD** §	150-B360NBR
500	150	257	5…150	5…200	5…400	**150-B500NBD** §	150-B500NBR
650	200	355	5…200	5…250	5…500	150-B650NBD §	150-B650NBR
720	220	400	5…250	5…300	5…600	150-B720NBD §	150-B720NBR
850	257	475	10…300	10…350	10…700	150-B850NBD §	150-B850NBR
1000	315	530	10…350	10…400	10…800	150-B1000NBD §	150-B1000NBR

∗ Controllers rated 97…360 A are not equipped with line and load terminal lugs. See [T-2097386] for terminal lug kits.
❄ The minimum rating is: 0.7 kW for devices with current ratings of 54 A or less; 4 kW for devices rated 97…720 A; 7.5 kW for devices rated 850 A and greater.
‡ Hp ratings at motor terminal voltages for 208, 480, and 600 line volts, respectively.
§ 120V AC control is required for heatsink fan operation.

Up to 575V AC

Current∗ Rating [A]	kW❄ 230V AC 50 Hz	kW❄ 400V AC 50 Hz	kW❄ 500V AC 50 Hz	Hp‡ 200V AC 60 Hz	Hp‡ 230V AC 60 Hz	Hp‡ 460V AC 60 Hz	Hp‡ 575V AC 60 Hz	100…240V AC 50/60 Hz Control Cat. No.	24V AC/DC Control Cat. No.
24	5.5	11	15	1…5	1…7.5	1…15	1…20	150-B24NCD	150-B24NCR
35	10	18.5	22	1…10	1…10	1…25	1…30	150-B35NCD	150-B35NCR
54	15	22	37	1…15	1…20	1…40	1…50	150-B54NCD	150-B54NCR
97	25	45	63	5…30	5…30	5…75	5…75	150-B97NCD §	150-B97NCR
135	37	75	90	5…40	5…50	5…100	5…125	150-B135NCD §	150-B135NCR
180	51	90	132	5…60	5…60	5…150	5…150	150-B180NCD §	150-B180NCR
240	75	132	160	5…75	5…75	5…200	5…250	150-B240NCD §	150-B240NCR
360	110	200	250	5…125	5…150	5…300	5…350	150-B360NCD §	150-B360NCR
500	150	257	355	5…150	5…200	5…400	5…500	150-B500NCD §	150-B500NCR
650	200	355	475	5…200	5…250	5…500	5…600	150-B650NCD §	150-B650NCR
720	220	400	500	5…250	5…300	5…600	5…700	150-B720NCD §	150-B720NCR
850	257	475	600	10…300	10…350	10…700	10…800	150-B850NCD §	150-B850NCR
1000	315	530	710	10…350	10…400	10…800	10…1000	150-B1000NCD §	150-B1000NCR

∗ Controllers rated 97…360 A are not equipped with line and load terminal lugs. See [T-2097386] for terminal lug kits.
❄ The minimum rating is: 0.7 kW for devices with current ratings of 54 A or less; 4 kW for devices rated 97…720 A; 7.5 kW for devices rated 850 A and greater.
‡ Hp ratings at motor terminal voltages for 208, 480, and 600 line volts, respectively.
§ 120V AC control is required for heatsink fan operation.

Open Type Options (only one selection allowed)

Option	Description	Cat. No. Modification
Soft Stop	Provides a ramp down time of 0…60 s for applications which require an extended coast-to-rest.	A§
Pump Control	Provides smooth motor acceleration and deceleration, reducing surges caused by the starting and stopping of centrifugal pumps. Starting time is adjustable from 0…30 s, and stopping time is adjustable from 0…120 s.	B§
Preset Slow Speed	Provides preset slow speeds for positioning or alignment applications. Preset speeds can be selected at either 7% or 15% of rated motor speed, with adjustable slow speed current from 0…450% of full-load motor current.	C§
SMB Smart Motor Braking	Provides a microprocessor-based braking system that applies 3-phase braking current to a standard squirrel-cage induction motor. The strength of the braking current is adjustable from 0…400% of the motor's full-load current rating.	D§
Accu-Stop	Provides stopping control for general positioning or to minimize jogging to stop. A 3-phase braking current is applied to the motor (adjustable from 0…400% of full-load current) until it reaches a preset slow speed (either 7% or 15% of rated motor speed). The motor is held at this speed until a stop command is given. Braking torque is then applied until the motor reaches zero speed. Slow speed current is adjustable from 0…450% of full-load current.	E§
Slow Speed with Braking	Provides a preset slow speed for positioning or alignment applications. Preset speeds can be selected at either 7% or 15% of rated motor speed, with adjustable slow speed current from 0…450% of full-load current. Provides a microprocessor-based braking system that applies 3-phase braking current to a standard squirrel-cage induction motor. The strength of the braking current is adjustable from 0…400% of full-load motor current.	F§

§ Add the designated letter to the end of the cat. no. Example: To add the Pump Control option: **Cat. No. 150-B24NBDB**.

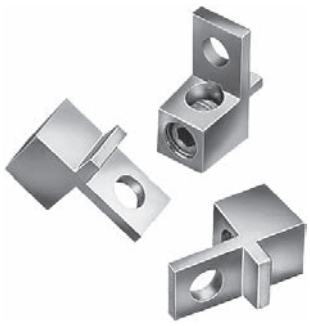
Protective Modules*♣

Current Rating [A]	Description	Field Modification Cat. No.
24…54	480 V Protective Module (Field Installed)	**150-N84**
	600 V Protective Module (Field Installed)	150-N86
97…360	480 V Protective Module (Field Installed)	**150-N84L**
	600 V Protective Module (Field Installed)	150-N86L

* The same protective module mounts on the line or load side of the SMC Dialog Plus Controller. For applications requiring both line and load side protection, two protective modules must be ordered.
♣ Surge protection is provided as standard on 500…1000 A units

4

Terminal Lug Kits (97…1000 A)



Current Rating [A]	Wire Size	Total No. of Terminal Lugs Possible Each Side		Pkg. Quantity	Cat. No.
		Line Side	Load Side		
97…135	#6…250 MCM AWG 16 mm²…120 mm²	3	3	3	**199-LF1**
180…360		6	6		
500‡	#4…500 MCM AWG 25 mm²…240 mm²	6	6		**199-LG1**
650…720‡		9	9		
850…1000‡	(2) 1/0…500 MCM AWG 50 mm²…240 mm²	6	6		**199-LJ1**

‡ Lugs are supplied with SMC.

IEC Terminal Covers

Description	Field Modification Cat. No.
IEC line- or load-side terminal covers for 97…135 A devices (includes line and load termination covers)	150-NT1
IEC line- or load-side terminal covers for 180…360 A devices (includes line and load termination covers)	150-NT2

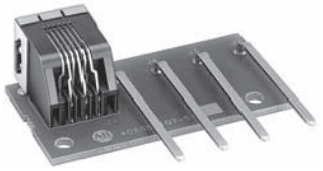
Description			Degree of Protection	Cat. No.
Cat. No. 1201-HAP	**Human Interface Module❖**	Door Mount Bezel Kit	IP30 (Type 1)	**1201-DMA**
		Programmer Only	IP30 (Type 1)✦	**1201-HAP**
Cat. No. 1201-HA1		Programmer Only	IP65 (Type 4/12) with Bezel	**1201-HJP**
		Analog Control Panel⌘	IP30 (Type 1)✦	**1201-HA1**
Cat. No. 1201-HA2		Digital Control Panel⌘	IP30 (Type 1)✦	**1201-HA2**
		Digital Control Panel⌘	IP65 (Type 4/12) with Bezel	**1201-HJ2**

Description				For Use With	Cat. No.
Communication Cable Cat. No. 1202-C10	**Communication Cable**	Male-Male	0.3 m	Human Interface Module and Communication Modules	**1202-C03**
			1 m		**1202-C10**
			3 m		**1202-C30**
			9 m		**1202-C90**
Communication Module Cat. No. 1203-GD1	**Communication Module❖**	RS-232/RS-422/RS-485/DF1, or DH485 (Series B)		Bulletin 150 SMC Dialog Plus	**1203-GD2**
		ControlNet			1203-CN1
		Enhanced DeviceNet			**1203-GU6**
Cat. No. 1203-FM1 ***Cat No. 1203-SM1*** ***Communication Option Kits***	**Flex I/O SCANport Module♣** Flex I/O Terminal Base			Bulletin 150 SMC Dialog Plus	**1203-FB1**
	Flex I/O Module➢				1203-FM1
	SLC Communication Module				**1203-SM1**

⌘ Start, Stop, and Jog buttons are the only active controls when used with the SMC Dialog Plus Controller.
✦ Requires Type 1 Door Mount Bezel Kit.
❖ Separately powered 120/240V AC.
♣ Each Flex I/O SCANport Module requires (1) Cat. No. 1203-FB1 and (1) Cat. No. 1203-FM1.
➢ Requires a Communication Option Cable (Cat. No. 1202-C03/C10/C30/C90) to be functional. These units are not acceptable for NEMA Type 4 door mounting or UL Type 4X outdoor only.

Converter Modules*

	Motor Full Load Current Range [A]	Cat. No.
Cat. No. 825-MCM180	2.5…20 A	**825-MCM20**
	9…100 A	**825-MCM180**
Cat. No. 825-MCM630	64…360 A	**825-MCM630**
Connection Cable (Replacement) Bul. 825-P to Bul. 825-MCM connection		**825-MCA**

	Description	Cat. No.
 *Cat. No. 150-NFS*	**Fanning Strip for Bulletin 825 Converter Modules**	**150-NFS**
	M8 connections Set of three 4 x 16 x 102 mm (1/8 x 5/8 x 4-1/64 in.) (125 A max.) Universally applicable Weight: 230 g	825-MVM

* Must be used with fanning strip Cat. No. 150-NFS.

Specifications

Functional Design Specifications			
Standard Features	Installation	Power Wiring	The SMC Dialog Plus Controller can be wired with or without an isolation contactor. Bypass contactors can be employed after the controller has brought the motor to full speed.
		Control Wiring	2- and 3-wire control for a wide variety of applications.
	Setup	Keypad	The SMC Dialog Plus Controller is configured with the front keypad and backlit LCD display.
		Software	Parameter values can be downloaded to the SMC Dialog Plus Controller with DriveTools programming software and the Cat. No. 1203-GD2 communication module.
	Communications		One serial port provided for connection to optional human interface and communication modules.
	Starting Modes		Soft start with selectable kickstart, current limit, dual ramp, and full voltage in one unit.
	Protection and Diagnostics		Power loss, line fault, voltage unbalance, excessive starts/hour, phase reversal, undervoltage, overvoltage, controller temp, stall, jam, open gate, overload, underload, communication fault.
	Metering		Amps, volts, kW, kWH, elapsed time, power factor, motor thermal capacity usage.
	Status Indication		Stopped, ramping, stopping, at speed, and fault.
	Auxiliary Contacts		(1) Single-pole double-throw contact programmable as normal or up-to-speed; one programmable as normal or fault.
Optional Features	Soft Stop		Extended coast-to-rest to minimize load shifting. Ramp down time is adjustable from 0…60 s.
	Pump Control		Helps reduce fluid surges in centrifugal pumping systems during starting and stopping period. Starting time is adjustable from 0…30 s. Stopping time is adjustable from 0…120 s.
	Preset Slow Speed		Enables the operator to position material. The preset slow speed can be set for low (7% of base speed), high (15% of base speed), reverse low (10% of base speed) or reverse high (20% of base speed).
	SMB Smart Motor Braking		Provides motor braking without additional equipment for applications that require the motor to stop quickly. Braking current is adjustable from 0…400% of the motor's full-load current rating.
	Accu-Stop/Slow Speed with Braking		Combines Smart Motor Braking and Preset Slow Speed. Braking current is adjustable from 0…400% of full-load current. Slow speed can be set for either Low (7% of base speed) or High (15% of base speed).

Electrical Ratings				
			UL/CSA/NEMA	IEC
Power Circuit	Rated Operation Voltage		200…480V AC 200…600V AC (–15%, +10%)	200…415V 200…500V
	Rated Insulation Voltage		N/A	500V
	Rated Impulse Voltage		N/A	6000V
	Dielectric Withstand		2200V AC	2500V
	Repetitive Peak Inverse Voltage Rating		200…480V AC: 1400V 200…600V AC: 1600V	200…415V: 1400V 200…500V: 1600V
	Operating Frequency		50/60 Hz	50/60 Hz
	Utilization Category		MG 1	AC-53a
	Protection Against Electrical Shock		N/A	IP00 (open device)
	DV/DT Protection		RC Snubber Network	
	Transient Protection		Metal Oxide Varistors: 220 Joules @ 24…360 A 220 Joules @ 480V, 500…1000 A 300 Joules @ 600V, 500…1000 A	
Short-Circuit Protection	SCPD Performance		Type 1	
	SCPD List		Maximum Fuse or Circuit Breaker (A):	
	Device Operational Current Rating [A]	24	80	
		35	125	
		54	200	
		97	350	
		135	500	
		180	600	
		240	700	
		360	1000	
		500	1200	
		650	1600	
		720	2000	
		850	2500	
		1000	3000	
Control Circuit	Rated Operational Voltage		100…240V AC 24V AC 24V DC	100…240V 24V 24V DC
	Rated Insulation Voltage		N/A	240V
	Rated Impulse Voltage		N/A	3000V
	Dielectric Withstand		1600V AC	2000V
	Operating Frequency		50/60 Hz	50/60 Hz
	Protection Against Electric Shock		N/A	IP20
Power Requirements	Control Module		40 VA	
	Heatsink Fan(s) [A]*	24	—	
		35	—	
		54	—	
		97	45 VA	
		135	45 VA	
		180	45 VA	
		240	45 VA	
		360	45 VA	
		500	145 VA	
		650	320 VA	
		720	320 VA	
		850	320 VA	
		1000	320 VA	

* For devices rated 24…500 A, heatsink fans can be powered by either 110/120V AC or 220/240V AC. For devices rated 650…1000 A, heatsink fans can only be powered by 110/120V AC.

Electrical Ratings, Continued				
			UL/CSA/NEMA	IEC
Maximum Heat Dissipation [W]	Current Rating [A]	24	110	
		35	150	
		54	200	
		97	285	
		135	490	
		180	660	
		240	935	
		360	1170	
		500	1400	
		650	2025	
		720	2250	
		850	2400	
		1000	2760	
Auxiliary Contacts	Rated Operation Voltage		240V AC	240V
	Rated Insulation Voltage		N/A	240V
	Dielectric Withstand		1600V AC	2000V
	Operating Frequency		50/60 Hz	50/60 Hz
	Utilization Category		B300 (terminals 18…19) C300 (terminals 18…20) C300 (terminals 29…30)	AC-15
	SCPD Performance		Type 2	
	SCPD List		Class CC 8 A @ 1000 A Available Fault Current	
Environmental				
Operating Temperature Range			0…+50 °C (32…122 °F) (open) 0…+40 °C (32…104 °F) (enclosed)	
Storage and Transportation Temperature Range			–20…+75 °C	
			2000 m (6560 ft)	
Humidity			5…95% (non-condensing)	
Pollution Degree			2	
Mechanical				
Resistance to Vibration	Operational Non-Operational		1.0 G Peak, 0.006 in. displacement 2.5 G, 0.015 in. displacement	
Resistance to Shock	Operational Non-Operational		15 G 30 G	
Construction	Power Poles	Thermoset Moldings Heatsink hockey puck thyristor	24…135 A 180…1000 A	
	Control Modules		Thermoset and Thermoplastic Moldings	
	Metal Parts		Anodized Aluminum, Plated Brass, Copper, or Painted Steel	
Terminals	Power Terminals	24…54 A	6.0 mm hole with clamp screw	
		97 and 135 A	One 11.5 mm (0.453 in.) diameter hole each	
		180…360 A	One 10.5 mm (0.413 in.) diameter hole each	
		500 A	Two 13.5 mm (0.531 in.) diameter holes each	
		650 and 720 A	Three 13.1 mm (0.515 in.) diameter holes each	
		850 and 1000 A	Six 13.1 mm (0.515 in.) diameter holes each	
	Power Terminal Markings		NEMA, CENELEC EN50 012	
	Control Terminals		M 3.5 x 0.6 Pozidriv screw with self-lifting clamp plate	
Other				
EMC Emission Levels	Conducted Radio Frequency Emissions Radiated Emissions		Class A Class A	
EMC Immunity Levels	Electrostatic Discharge		8 kV Air Discharge	
	Radio Frequency Electromagnetic Field		Per IEC 947-4-2	
	Fast Transient		Per IEC 947-4-2	
	Surge Transient		Per IEC 947-4-2	
Overload Characteristics	Current Range		1.0…999.9 A	
	Trip Classes		10, 15, 20, and 30	
	Trip Current Rating		120% of Motor FLC	
	Number of Poles		3	

Fuse Clip Sizing and Type for Fusible Combination Controllers∗❄

Horsepower @ 480V	Fuse Clip Size/Type	Fuse Size Range [A]
15	30 A/Class J	0…30
20	60 A/Class J	31…60
25	60 A/Class J	31…60
30	60 A/Class J	31…60
40	100 A/Class J	61…100
50	100 A/Class J	61…100
60	200 A/Class J	101…200
75	200 A/Class J	101…200
100	200 A/Class J	101…200
125	400 A/Class J	201…400
150	400 A/Class J	201…400
200	400 A/Class J	201…400
250	400 A/Class J	401…600
300	600 A/Class J	401…600
350	600 A/Class J	401…600
400	1200 A/Class L	601…1600
450	1200 A/Class L	601…1600
500	1200 A/Class L	601…1600
600	1200 A/Class L	601…1600
700	1200 A/Class L	601…1600
800	1200 A/Class L	601…1600

∗ Consult NEC Handbook for proper fuse sizing guidelines.

❄ Optional fuse clip sizes and types are available upon request. Consult your local Rockwell Automation sales office or Allen-Bradley distributor.

Circuit Breaker Sizes and Rating Plug Sizes

Horsepower @ 480V	Circuit Breaker Size [A]/ Rating Plug Size [A]	Interrupting Rating in Symmetrical Amps @ 480V‡
15	150/50	14 000
20	150/50	14 000
25	150/60	14 000
30	150/70	14 000
40	150/100	14 000
50	150/125	14 000
60	250/150	25 000
75	250/175	25 000
100	250/225	25 000
125	250/250	25 000
150	400/300	35 000
200	400/400	35 000
250	600/500	35 000
300	600/600	35 000
350	800/800	35 000
400	800/800	50 000
450	1200/1000	50 000
500	1200/1200	50 000
600	1200/1200	50 000
700	2000/1600	65 000
800	2000/2000	65 000

‡ For higher interrupting ratings, consult your local Rockwell Automation sales office or Allen-Bradley distributor.

Approximate Dimensions and Shipping Weights

Open Type Controllers

Dimensions are in millimeters (inches). Dimensions are not intended for manufacturing purposes.

Controller Rating [A]	Height	Width	Depth	Weight
24	180 (7.09)	154 (6.06)	185 (7.29)	4.5 kg (10 lbs)
35	240 (9.45)	214 (8.43)	195 (7.68)	6.8 kg (15 lbs)
54	290 (11.42)	244 (9.61)	225 (8.86)	11.3 kg (25 lbs)
97	336 (13.23)	248 (9.77)	256 (10.09)	10.4 kg (23 lbs)
135	336 (13.23)	248 (9.77)	256 (10.09)	11.8 kg (26 lbs)
180	560 (22.06)	273 (10.75)	294 (11.58)	25 kg (55 lbs)
240	560 (22.06)	273 (10.75)	294 (11.58)	30 kg (65 lbs)
360	560 (22.06)	273 (10.75)	294 (11.58)	30 kg (65 lbs)
500	588 (23.17)	508 (20.00)	311 (12.23)	40.8 kg (90 lbs)
650…1000	1524 (60.0)	813 (32.00)	402 (15.83)	167.8 kg (370 lbs)

Bulletin 156 — Solid-State Contactors

The Bulletin 156 Solid-State Contactors are ideal replacements for electro-mechanical contactors where fast and demanding switching of loads such as heaters, solenoids, transformers, and motors, is required.

- Compact modular design complete with heatsink
- Panel or DIN Rail mountable
- Simple installation
- Available in single-phase, dual-phase, or three-phase version
- Operational current rating 20…90 A
- LED status indication
- AC, DC, and analog control options
- 2 back-to-back SCR switching elements per phase
- Zero-cross switching
- Integrated varistor for surge protection

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Standards Compliance

UL 508
CSA C22.2, No.14
IEC 60947-4-2

Certifications

cULus Listed (File No. E96956, Guides NMFT, NMFT7)
CE per IEC 60947-4-2/3

Single-Phase‡

Current Rating [A]	Control Voltage	Hp Rating @ 40 °C (104 °F) 115V	230V	480V❄	600V❄	Operational Voltage 24…230V AC Cat. No.	42…600V AC Cat. No.
20	24…275V AC, 24…48V DC	1/6	1/2	1	2	**156-B20AA1**	**156-B20CA1**
	5…24V DC					**156-B20AB1**	**156-B20CB1**
30	24…275V AC, 24…48V DC	1/2	1-1/2	3	5	**156-B30AA1**	**156-B30CA1**
	5…24V DC					**156-B30AB1**	**156-B30CB1**
45	24…275V AC, 24…48V DC	1	2	5	7-1/2	156-B45AA1	**156-B45CA1**
	5…24V DC					**156-B45AB1**	**156-B45CB1**
50	24…275V AC, 24…48V DC	1	2	5	7-1/2	**156-B50AA1**	**156-B50CA1**
	5…24V DC					156-B50AB1	**156-B50CB1**
70	24…275V AC, 24…48V DC	1-1/2	3	5	10	156-B70AA1	**156-B70CA1**
	5…24V DC					156-B70AB1	**156-B70CB1**
75	24…275V AC, 24…48V DC	1-1/2	3	5	10	♣ 156-B75AA1	♣ **156-B75CA1**
	5…24V DC					♣ 156-B75AB1	♣ **156-B75CB1**
90	24…275V AC, 24…48V DC	1-1/2	3	5	10	♣ 156-B90AA1	♣ 156-B90CA1
	5…24V DC					♣ 156-B90AB1	♣ **156-B90CB1**

‡ Includes an integrated varistor for surge protection.
❄ These Hp ratings only apply to units with operational voltage ranges of 42…600V AC.
♣ Includes an integrated fan in the heat sink assembly. Fan will automatically switch on when necessary (approximately 125 °C internal temp.). Includes overtemperature protection. See page 4-189 for details.

Dual-Phase‡

Current Rating [A]	Control Voltage	Hp Rating @ 40 °C (104 °F) 115V	230V	480V❄	600V❄	Operational Voltage 24…230V AC Cat. No.	48…600V AC Cat. No.
25	24…275V AC, 24…190V DC	1	3	5	7-1/2	**156-B25AA2**	**156-B25CA2**
	5…24V DC					**156-B25AB2**	**156-B25CB2**
32	24…275V AC, 24…190V DC	1	3	7-1/2	10	156-B32AA2	**156-B32CA2**
	5…24V DC					156-B32AB2	**156-B32CB2**

‡ Includes an integrated varistor for surge protection.
❄ These Hp ratings only apply to units with operational voltage ranges of 48…600V AC.

Three-Phase

Current Rating [A]	Control Voltage	Hp Rating @ 40 °C (104 °F) 115V	230V	480V❄	600V❄	Operational Voltage 24…230V AC Cat. No.	48…600V AC Cat. No.
20	24…275V AC, 24…190V DC	1	3	5	7-1/2	156-B20AA3	**156-B20CA3**
	5…24V DC	1	3	5	7-1/2	**156-B20AB3**	**156-B20CB3**
25	24…275V AC, 24…190V DC	1	3	7-1/2	10	**156-B25AA3**	**156-B25CA3**
	5…24V DC	1	3	7-1/2	10	156-B25AB3	**156-B25CB3**
32	24…275V AC, 24…190V DC	1	3	7-1/2	10	♣ 156-B32AA3	♣ **156-B32CA3**
	5…24V DC	1	3	7-1/2	10	♣ **156-B32AB3**	♣ **156-B32CB3**

❄ These Hp ratings only apply to units with operational voltage ranges of 48…600V AC.
♣ Includes an integrated fan in the heat sink assembly. Fan will automatically switch on when necessary (approximately 125 °C internal temp.). Includes overtemperature protection. See page 4-190 for details.

Solid-State Specialty Contactors

Single-Phase with Current Monitoring✶

Current Rating [A]	Supply Voltage	Control Voltage	Rated Hp @ 40 °C (104 °F), 50/60 Hz				Alarm Type	Operational Voltage	
			115V AC	230V AC	480V AC❄	600V AC❄		24…265V AC	42…660V AC
								Cat. No.	
30	24V DC	4…32V DC	3/4	2	5	5	PNP, N.O.	156-B30ABP	156-B30CBP
							NPN, N.O.	156-B30ABN	156-B30CBN
50			1	2	5	7-1/2	PNP, N.O.	156-B50ABP	156-B50CBP
							NPN, N.O.	156-B50ABN	156-B50CBN

❄ These Hp ratings only apply to units with operational voltage ranges of 42…660V AC.
✶ For current monitoring range, please see additional specifications on page 4-172 and monitoring Operations data on page 4-189.

Single-Phase, Single-Pole, Multi-function Analog§

Current Rating [A]	Control Input	Operational Voltage		
		90…265V AC	200…550V AC	410…660V AC
		Cat. No.		
30	0…10V DC‡	156-B30AV1	156-B30BV1	156-B30CV1
	4…20 mA	156-B30AC1	156-B30BC1	156-B30CC1
50	0…10V DC‡	156-B50AV1	156-B50BV1	156-B50CV1
	4…20 mA	156-B50AC1	**156-B50BC1**	156-B50CC1

§ See additional specifications, see page 4-173 and current monitoring data on page 4-193.
‡ Requires a 24V AC/DC supply to power the control circuitry of the solid-state contactor. See wiring diagrams on page 4-175 for additional details.

4

Specifications

General								
		Single-Phase and Single-Phase with Current Monitoring		Dual- and Three-Phase		Single-Phase with Analog Control		
Nominal Voltage Rating		230V AC	400/480/600V AC	230V AC	400/480 /600V AC	230V AC	400/480V AC	600V AC
Operational Voltage Range		24…265V AC	42…660V AC	24…280V AC	48…660 V AC	90…265V AC	200…550V AC	410…660V AC
Blocking Voltage		650Vp	1200Vp	650Vp	1200Vp	650Vp	1200Vp	1200Vp
Operational frequency		45…65 Hz						
Power Factor Minimum		≥ 0.5 @ 230V AC rms	≥ 0.5 @ 600V AC rms	≥ 0.5 @ 230V AC rms	≥ 0.5 @ 600V AC rms	≥ 0.9 @ 230V AC rms	≥ 0.9 @ 480V AC rms	≥ 0.9 @ 600V AC rms
Rated Insulation Voltage — Input to output, output to case		4000V AC rms						
Relay ON Indication		Green LED, ON when control input is detected						
Overtemp Alarm ON Indication*		Red LED, on when the solid-state contactor (SSC) temperature switching element (SCR) temperature is exceeded. SSC output (load) will switch OFF (Green LED: OFF). When overtemperature condition is removed, red LED will go OFF and normal operation will continue on the control input cycle.						
Overtemp Alarm*	*I* max.	50 mA DC	50 mA DC	50 mA DC	50 mA DC	—	—	—
	U max.	50V DC	50V DC	50V DC	50V DC	—	—	—
Standards Compliance		cULus						
Environmental								
Operating Temperature		-30…+70 °C (-22…+158 °F)						
Storage Temperature		-40…+100 °C (-40…+212 °F)						
RoHS Compliance		Yes						
Vibration		6 G (per EN50155)						
Pollution Degree		2						
Mechanical								
Housing Material		PBT, Flame Retardent						
Heat Sink Material		Black Anodized Aluminum						
Din Rail Mount Base		Electroplated Steel						
Mounting		Vertical						
Approximate Weight	22.5 mm	0.225 kg (0.5 lb)						
	45 mm	0.43 kg (0.95 lb)						
	45 mm with Integrated Fan	0.46 kg (1.0 lb)						
	90 mm	0.75 kg (1.65 lb)						
	90 mm with Integrated Fan	0.78 kg (1.72 lb)						

Contactor Type		Single Phase		Dual- and Three-phase
Package Size		**22.5 mm**	**45 and 90 mm**	**45 and 90 mm**
Control Terminals	Screw Type	M4	M3	M3
	min wire size	1 x 0.5 mm² (1 x 20 AWG)	1 x 0.5 mm² (1 x 20 AWG)	**(one wire min. & max.)** 1 x 0.5 mm² (1 x 20 AWG)…1 x 4.0 mm² (1 x 12 AWG)
	max wire size	2 x 2.5 mm² (2 x 14 AWG)	1 x 4.0 mm² (1 x 12 AWG) or 2 x 2.5 mm² (2 x 1 4 AWG)	**(two wire min. & max.)** 2 x 0.5 mm² (2 x 20 AWG)…2 x 2.5 mm² (2 x 1 4 AWG)
	max torque	2 N•m	0.6 N•m	0.6 N•m
	bit type	posidrive 1 bit	posidrive 0 bit	posidrive 0 bit
Power Terminals	Screw Type	M4	M5	M3
	min wire size	1 x 0.5 mm² (1 x 20 AWG)	1 x 4.0 mm² (1 x 12 AWG)	**(one wire min. & max.)** 1 x 0.5 mm² (1 x 20 AWG)…1 x 4.0 mm² (1 x 12 AWG)
	max wire size	2 x 2.5 mm² (2 x 14 AWG)	1 x 25 mm² (1 x 3 AWG) or 2 x 10 mm² (2 x 6 AWG)	**(two wire min. & max.)** 2 x 0.5 mm² (2 x 20 AWG)…2 x 2.5 mm² (2 x 14 AWG)
	max torque	2 N•m	2.5 N•m	0.6 N•m
	bit type	posidrive 1 bit	posidrive 2 bit	posidrive 0 bit

* Alarm capability exists on 1-phase 75 and 90 A, 5…24V DC control and 3-phase 32 A, 5…24V DC control units.

Control Input				
	Single-Phase, Single-Phase with Current Monitoring, and Single-Phase with Analog Control		Dual- and Three-Phase	
Control voltage range (±10%)	DC	AC/DC	DC	AC/DC
Control Voltage Range	4…32V	24…275V AC/24…48V DC	5…32V DC	24…275V AC/24…190V DC
Pick Up Voltage	3.8V DC	22V AC/DC	4.7V DC	22V AC/DC
Reverse Voltage	32V DC	—	32V DC	—
Drop Out Voltage	1.2V DC	6V AC/DC	1.2V DC	6V AC/DC
Maximum Input Current	12 mA	17 mA	24 mA	15 mA
Maximum Response Time Pick Up and Drop Out	1/2 Cycle	1 Cycle	1 Cycle	1 Cycle

Power Output												
			Rated Operational Current❄➢									
		Housing Size [mm]	AC51 @ 25 °C	AC53a @ 25 °C	Min. Oper. Current	Max. Repetitive Overload Current (ACrms) t = 1 s	Non-Repetitive Surge Current (ACrms) Tj = 25 °C t = 10 ms	Max. Off-State Leakage Current @ Rated Voltage and Frequency Tj = 25 °C t = 10 ms	I^2t for Fusing t = 10 ms§	Max. SCCR (65 kA) Fuse Current ‡	On-State Voltage Drop @ Rated Current Tj = 25 °C t = 10 ms	Critical dV/dT Off-State
Single-Phase	156-B20…1	22.5	20 A	5 A	350 mA	35 A	300 A	3 mA	450 A^2s	20 A	1.6 Vrms	500 V/uS
	156-B30…1	22.5	30 A	15 A	250 mA	125 A	600 A	3 mA	1800 A^2s	40 A	1.6 Vrms	500 V/uS
	156-B45…1	45	45 A	20 A	400 mA	150 A	1150 A	3 mA	6600 A^2s	60 A	1.6 Vrms	500 V/uS
	156-B50…1	45	50 A	30 A	500 mA	200 A	1900 A	3 mA	18000 A^2s	90 A	1.6 Vrms	500 V/uS
	156-B70…1	90	70 A	30 A	500 mA	200 A	1900 A	3 mA	18000 A^2s	90 A	1.6 Vrms	500 V/uS
	156-B75…1	45 with fan♣	75 A	30 A	500 mA	200 A	1900 A	3 mA	18000 A^2s	90 A	1.6 Vrms	500 V/uS
	156-B90…1	90 with fan♣	90 A	30 A	500 mA	200 A	1900 A	3 mA	18000 A^2s	90 A	1.6 Vrms	500 V/uS
Dual-Phase	156-B25…2	45	25 A	15 A	250 mA	125 A	600 A	3 mA	1800 A^2s	40 A	1.6 Vrms	500 V/uS
	156-B32…2	90	32 A	15 A	250 mA	125 A	600 A	3 mA	1800 A^2s	40 A	1.6 Vrms	500 V/uS
Three-Phase	156-B20…3	45	20 A	15 A	250 mA	125 A	600 A	3 mA	1800 A^2s	40 A	1.6 Vrms	500 V/uS
	156-B25…3	90	25 A	15 A	250 mA	125 A	600 A	3 mA	1800 A^2s	40 A	1.6 Vrms	500 V/uS
	156-B32…3	45 with fan♣	32 A	15 A	250 mA	125 A	600 A	3 mA	1800 A^2s	40 A	1.6 Vrms	500 V/uS
Single-Phase with Current Monitoring	156-B30…	45	30 A	15 A	150 mA	125 A	600 A	5 mA	1800 A^2s	40 A	1.6 Vrms	1000 V/uS
	156-B50…	45	50 A	30 A	500 mA	200 A	1900 A	5 mA	18000 A^2s	90 A	1.6 Vrms	1000 V/uS
Single-Phase with Analog Control	156-B30…	45	30 A	—	150 mA	55 A	325 A	3 mA	525 A^2s	30 A	1.6 Vrms	1000 V/uS
	156-B50…	45	50 A	—	500 mA	200 A	1900 A	3 mA	18000 A^2s	90 A	1.6 Vrms	1000 V/uS

❄ AC51 indicates a resistive load. For details, refer to IEC 60947-4-3. AC53a indicates an inductive (motor) load. For details, refer to IEC 60947-4-2.
§ To potentially protect the solid-state contactor from a short-circuit condition, select a semiconductor fuse with an I^2T value less than the one indicated below for the SSC.
‡ Provides Type 1 protection using a Class J or CC fuse.
♣ Includes an integrated fan in the heat sink assembly. Fan will automatically switch on when necessary (approximately 125 °C internal temp.). DC control Includes overtemperature alarm cutout.
➢ Current per each phase.

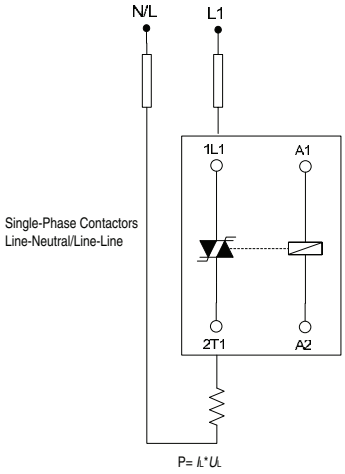
Power Dissipation		
	Size [A]	Power Dissipation [W/A]
Single-Phase	20	1.10
	30	0.95
	45	0.90
	50	0.85
	75	0.90
	70	0.90
	90	0.93
Dual-Phase	25/32	2.80
Three-Phase	20/25/32	1.92
Single-Phase with Current Monitoring	30	1.00
	50	0.85
Single-Phase with Multi-Function Analog Control	30	0.95
	50	0.85

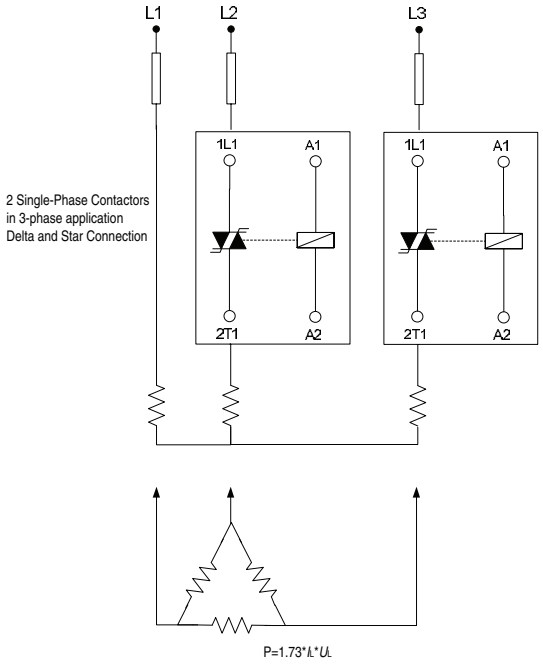
Additional Specifications that only apply to the Single-Phase with Current Monitoring Contactor		
Supply Status Indication		Green LED, Half Intensity
Control Status Indication		Green LED
Overtemp Alarm Trip Indication		Red LED, Intermittent
Alarm Indication (except for overtemp alarm)		Red LED
Power Supply Voltage, Vcc		24V DC +/- 15%
Maximum Supply Currrent		22 mA (per device)
Maximum Control Input Current		1.5 mA
Maximum PLC Current @ 24 VDC		275 uA (per device)
Alarm Output Current, Maximum		50 mA DC
Alarm Output Voltage	NPN (N.O.)	1 + 0.15 Io
	PNP (N.O.)	VCC - 1 - 0.15 Io
Maximum number of Parallel Outputs		≤ 50
Current Monitoring Measurement Range	30 A	0.3 … 30 A AC rms
	50 A	0.5 … 50 A AC rms
Minimum Teach Current	30 A	0.3 A AC rms
	50 A	0.5 A AC rms
Minimum Partial Load Current	30 A	50 mA AC rms
	50 A	83 mA AC rms

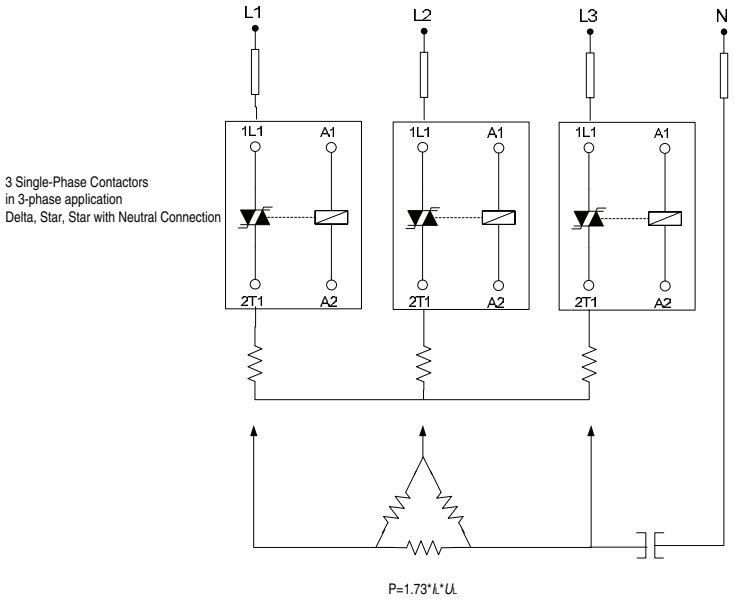
Additional Specifications that only apply to the Single-Phase with Multi-Function Analog Control Contactor			
Load Status Indication		Red LED	
Control Status Indication		Green LED	
Current Controlled Input Specifications	Control Current Range	4…20 mA	
	Max. Allowable Current	50 mA	
	Pick Up Current	4.2 mA	
	Drop Out Current	3.9 mA	
	Reverse Polarity Protected	Yes	
	Voltage Drop	10V DC @ 20 mA	
Voltage Controlled Input Specifications	Supply Voltage Range, Vss§	20…28V AC/DC	
	Supply Current§	18 mA @ 24V DC 23 mA @ 24V AC	
	Control Voltage Range, Vcc	0…10V DC	
	Control Input Current	0.1 mA @ 10V DC	
	Reverse Polarity Protected	Yes	
	Pick up Voltage	0.5V DC	
	Drop out Voltage	0.05V DC	
Output Power Range		0…99%	
Transfer Characteristics - Output Power %		Current Control Level	Voltage Control Level
	0%	4 mA	0V DC
	25%	8 mA	2.5V DC
	50%	12 mA	5V DC
	75%	16 mA	7.5V DC
	99%	20 mA	10V DC
Output Power Resolution	Mode 1 - Phase Angle	1/300 @ 50 Hz , 1/300 @ 60 Hz	
	Mode 2 - Full Cycle	1/64 @ 50 Hz , 1/64 @ 60 Hz	
	Mode 3 - 1 Sec Burst	1/50 @ 50 Hz , 1/60 @ 60 Hz	
	Mode 4 - 3 Sec Burst	1/150 @ 50 Hz , 1/180 @ 60 Hz	
	Mode 5 - 10 Sec Burst	1/500 @ 50 Hz , 1/600 @ 60 Hz	

§ The 0…10V DC type contactor requires a 24V AC/DC supply to power the control circuitry of the solid-state contactor.

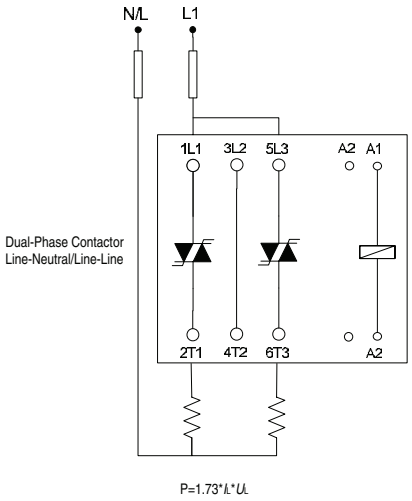
Applications for Non-Motor Loads

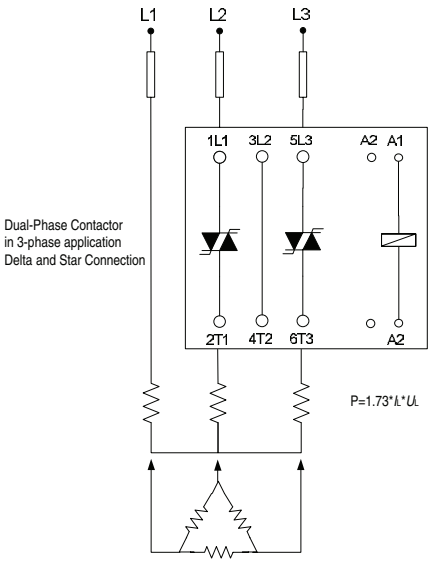


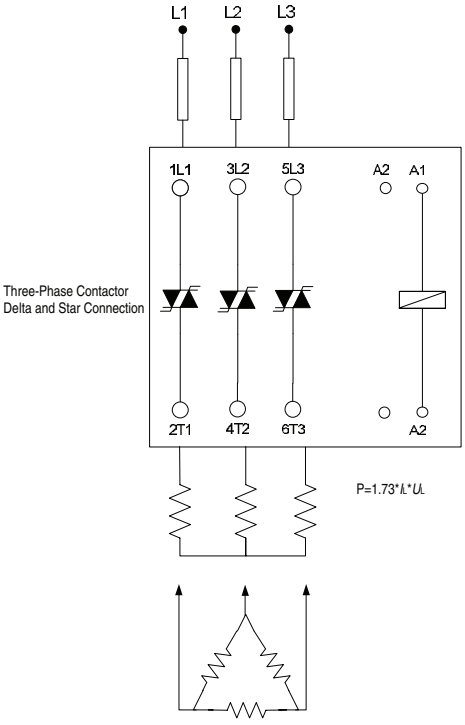




Applications for Non-Motor Loads, Continued

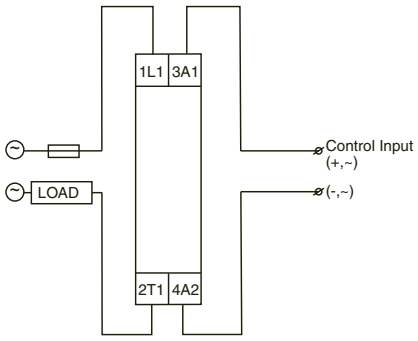






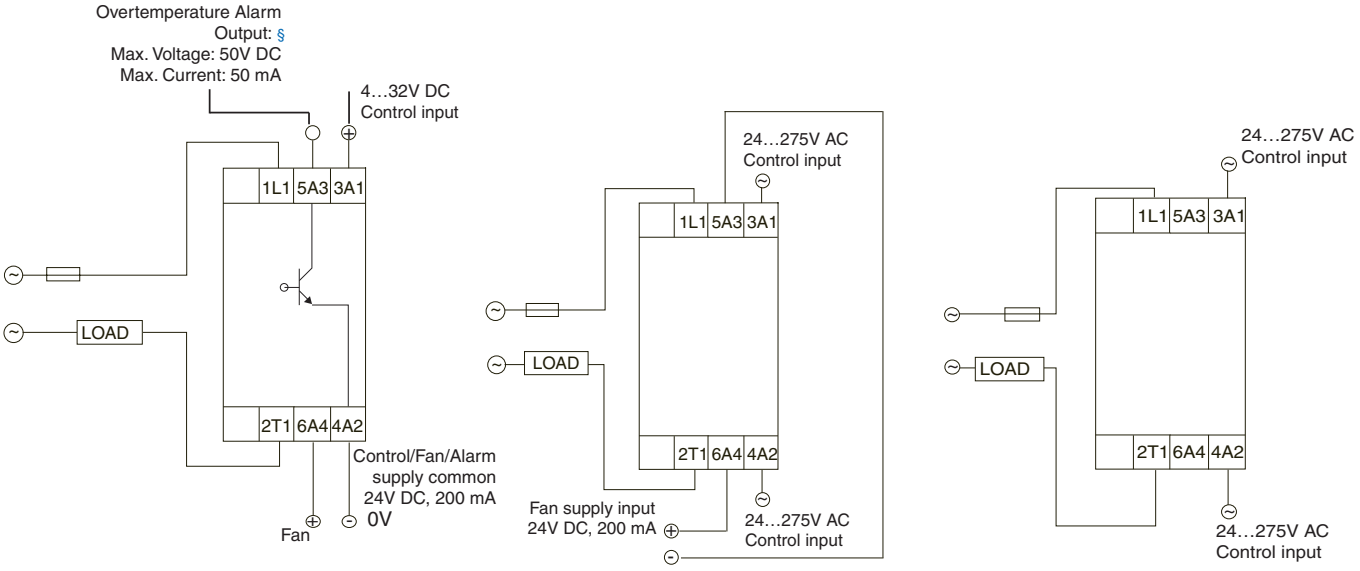
Typical Wiring Diagrams

Single-Phase



156-B…1

22 mm Device



DC control with fan ❄
Example: 156-B75CB1

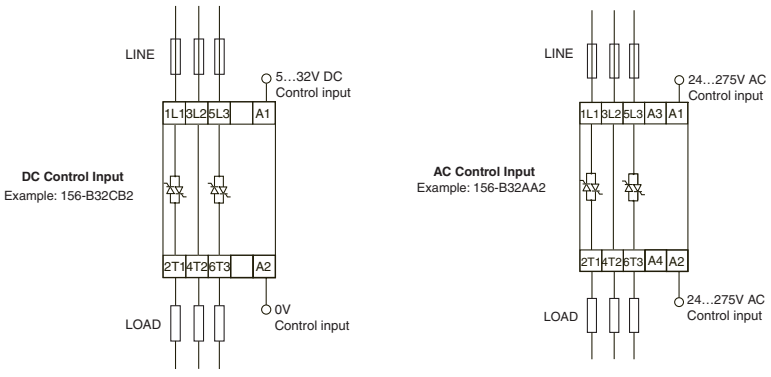
AC control with fan ❄
Example: 156-B75CA1

AC control without fan ❄
Example: 156-B50CA1

45 or 90 mm Device

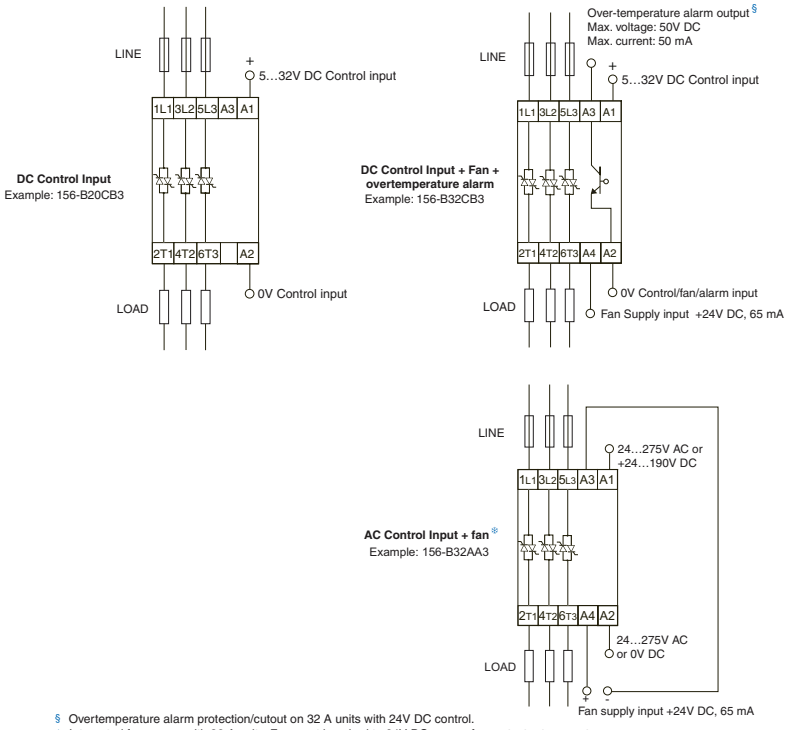
§ Overtemperature alarm protection/cutout on 75 and 90 A units with 24V DC control.
❄ Integrated fan comes with 75 and 90 A units. Fan must be wired to 24V DC source for contactor to operate.

Dual-Phase



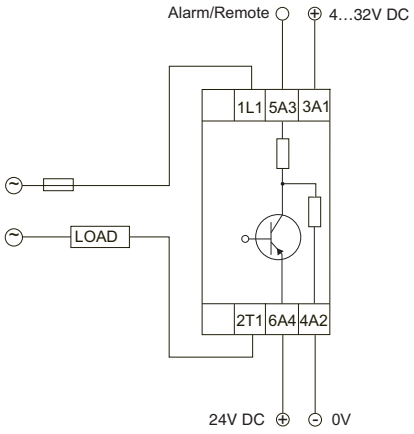
Typical Wiring Diagrams, Continued

Three-Phase



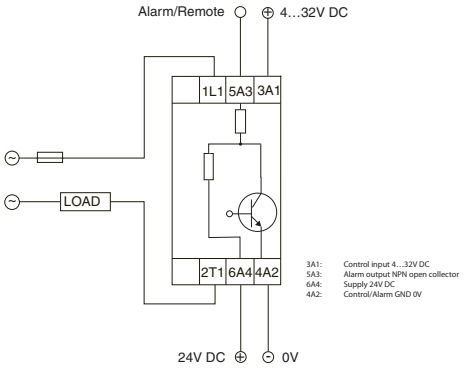
§ Overtemperature alarm protection/cutout on 32 A units with 24V DC control.
❄ Integrated fan comes with 32 A units. Fan must be wired to 24V DC source for contactor to operate.

Single-Phase with Current Monitoring (PNP)

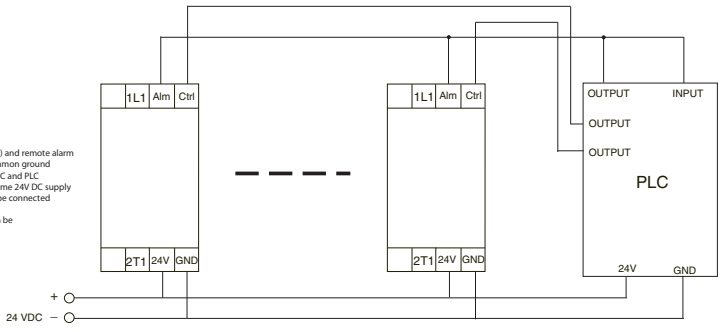


3A1: Control input 4…32V DC
5A3: Alarm output PNP open collector
6A4: Supply 24V DC
4A2: Control/Alarm GND 0V

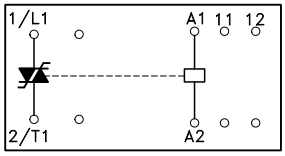
Single-Phase with Current Monitoring (NPN)



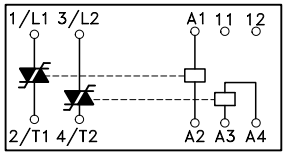
Notes:
1. Control input (terminal A1) and remote alarm (terminal A3) must have common ground
2. The current monitoring SSC and PLC must be sourced from the same 24V DC supply
3. PNP and NPN should not be connected to the same alarm line
4. A maximum of 6 loads can be connected in parallel



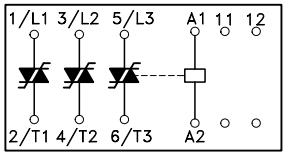
Single-phase



Dual-phase

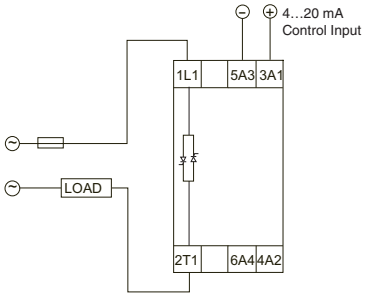


Three-phase

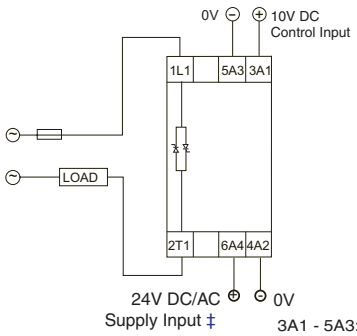


Typical Wiring Diagrams, Continued

Multi-function Analog



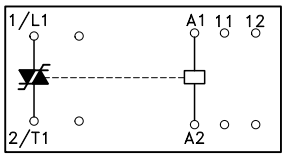
3A1 - 5A3: Control input current
Example: 156-B30BC1



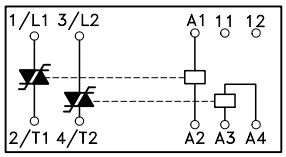
3A1 - 5A3: Control input voltage, Vcc
4A2 - 6A4: Supply input voltage, Vss
Example: 156-B30BV1

‡ Requires a 24V AC/DC supply to power the control circuitry of the solid-state contactor.

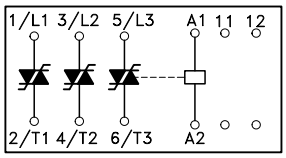
Single-phase



Dual-phase

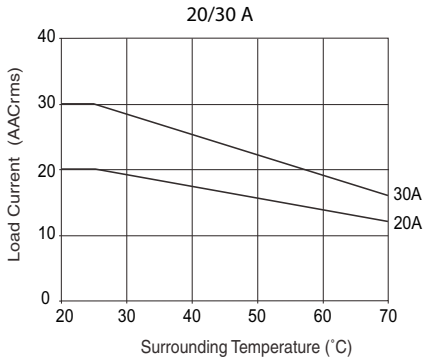


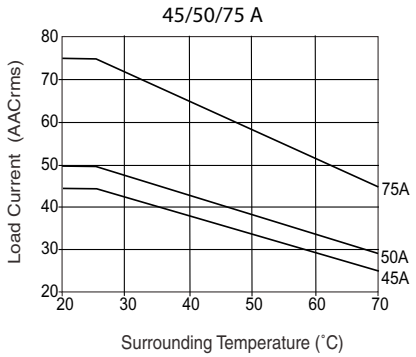
Three-phase

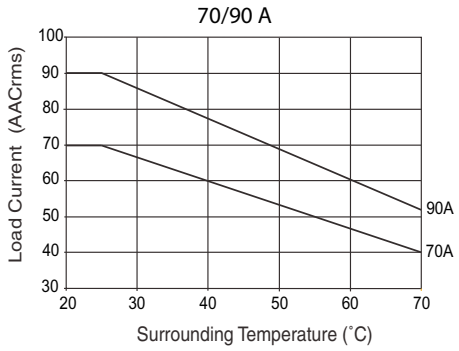


Load Versus Ambient Temperature Derating Curves

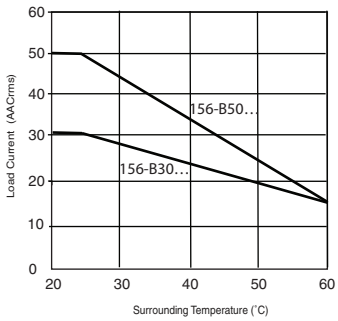
Single-Phase (Standard)





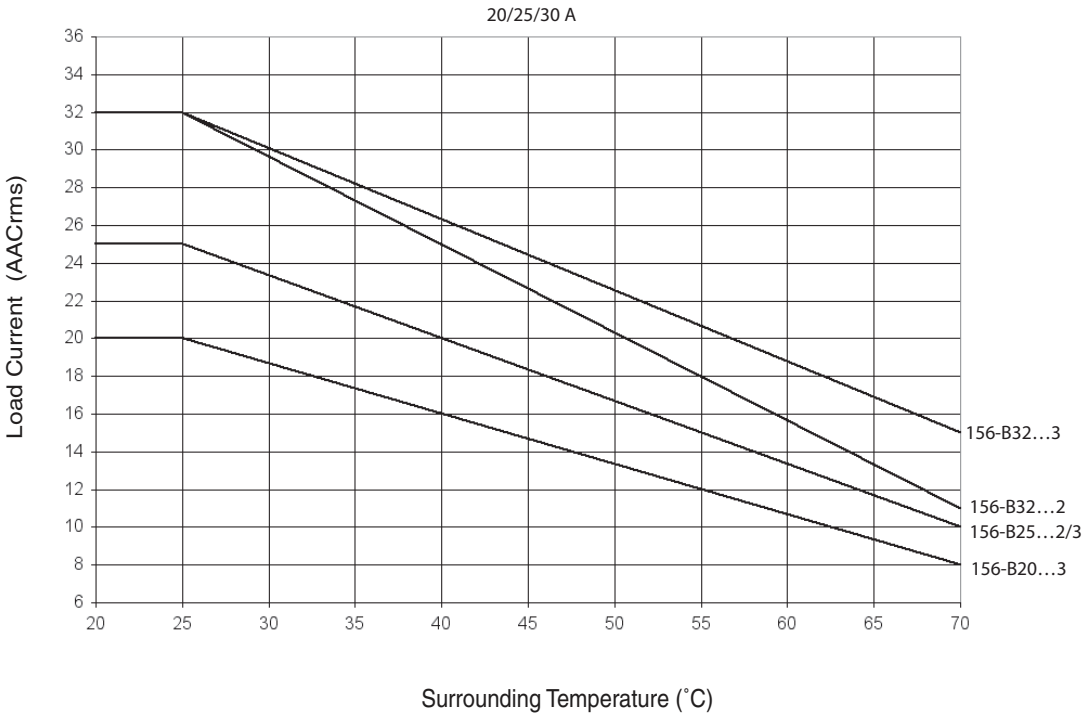


Single-Phase (Current Monitoring and Multifunction Analog)

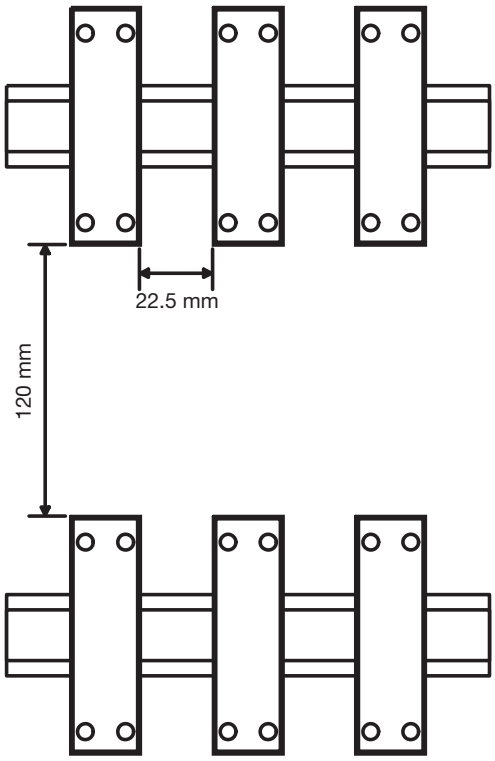


Note: Based on 100% duty cycle

Dual- and Three-Phase

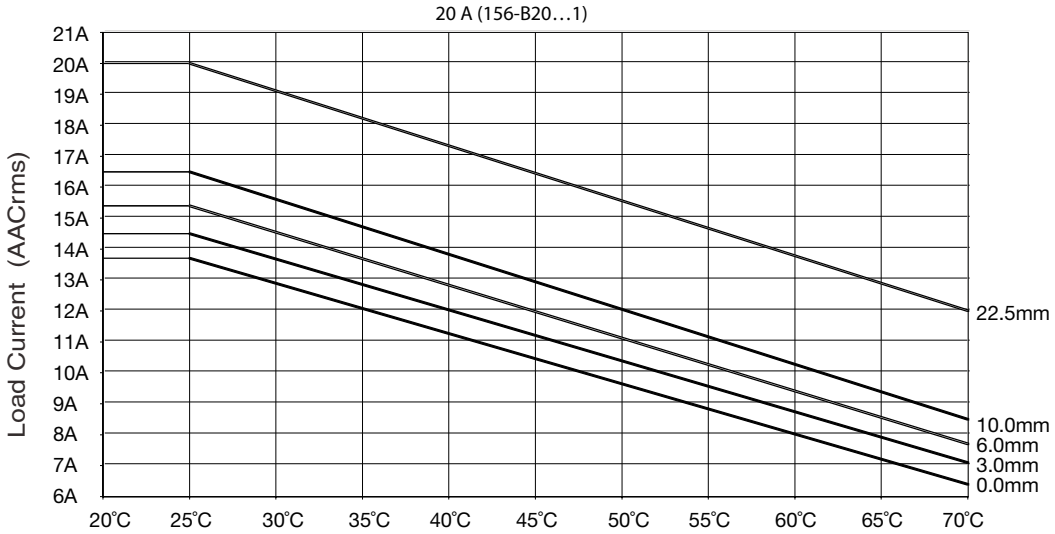


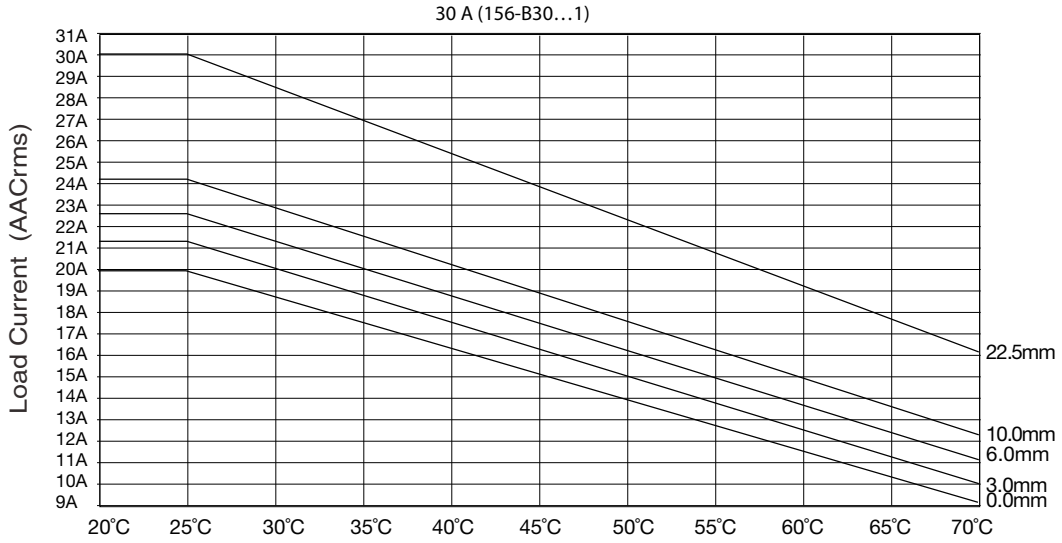
Panel Mounting Recommended Contactor Spacings

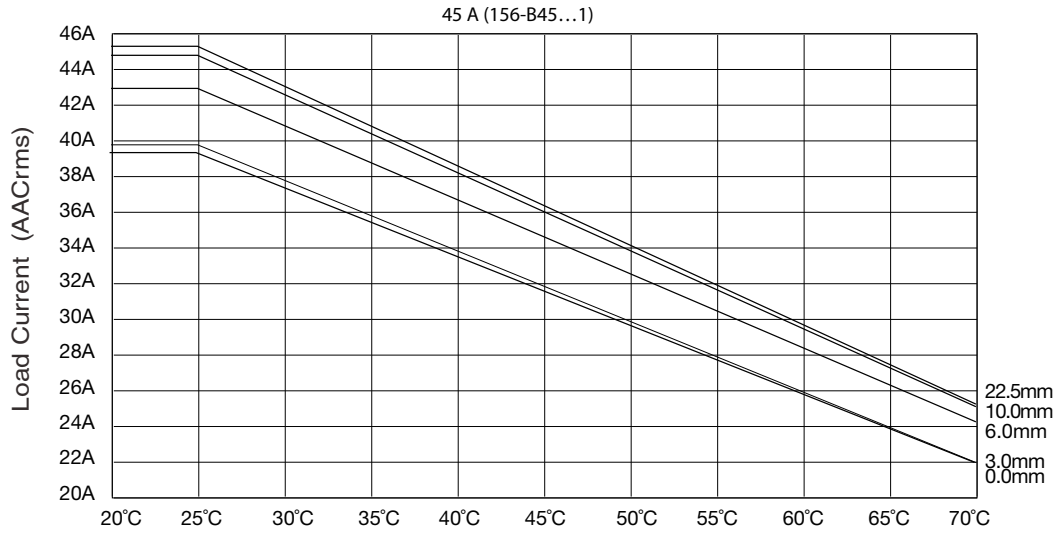


Panel Mounting Load Derating vs. Spacing Curves

Single-Phase

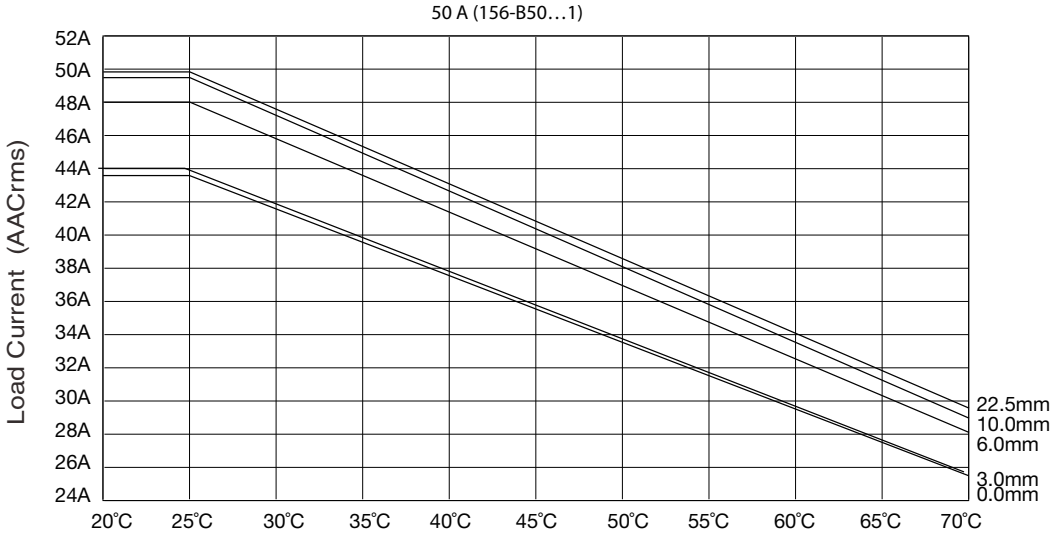


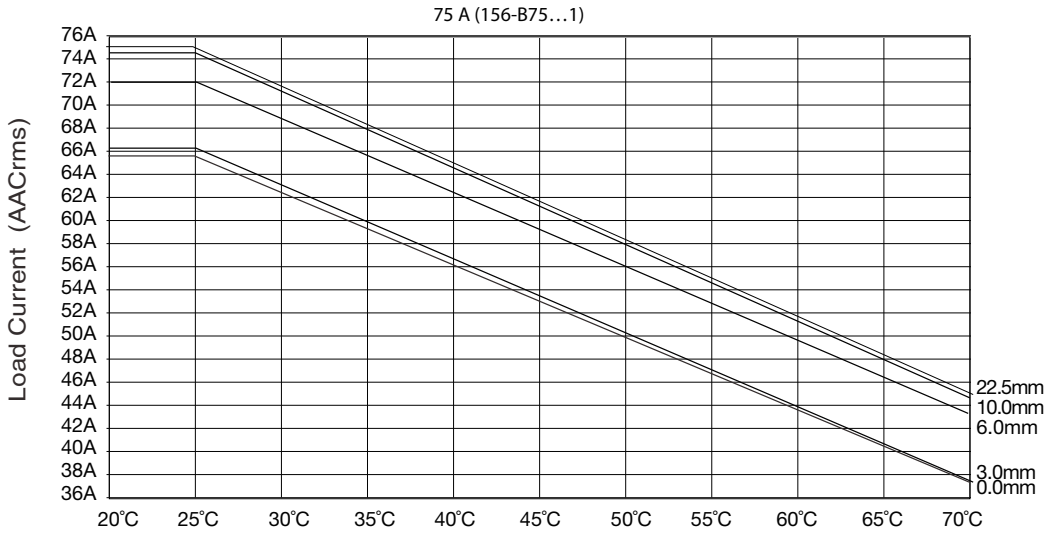




Panel Mounting Load Derating vs. Spacing Curves, Continued

Single-Phase

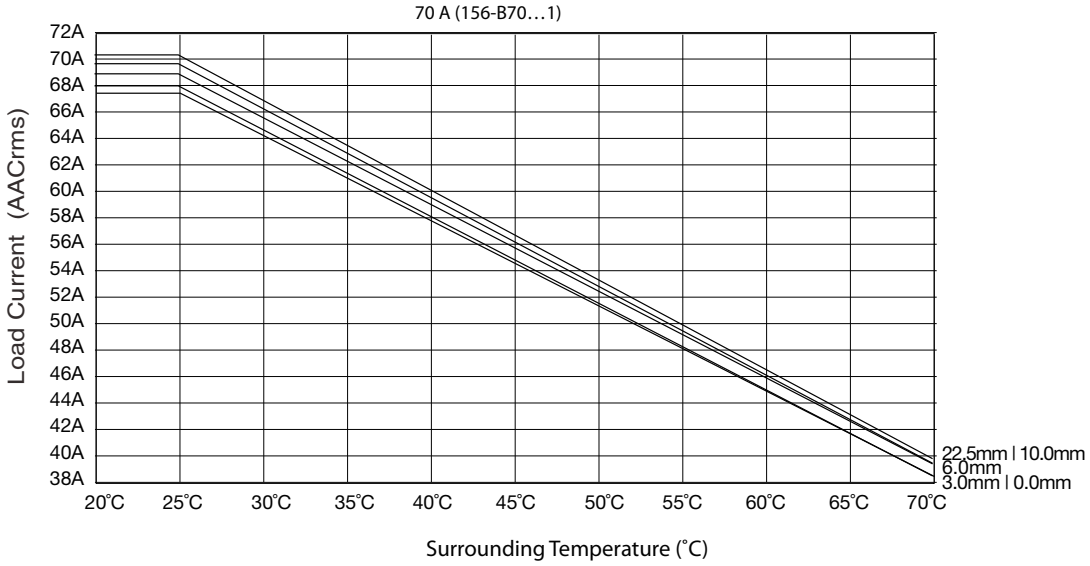


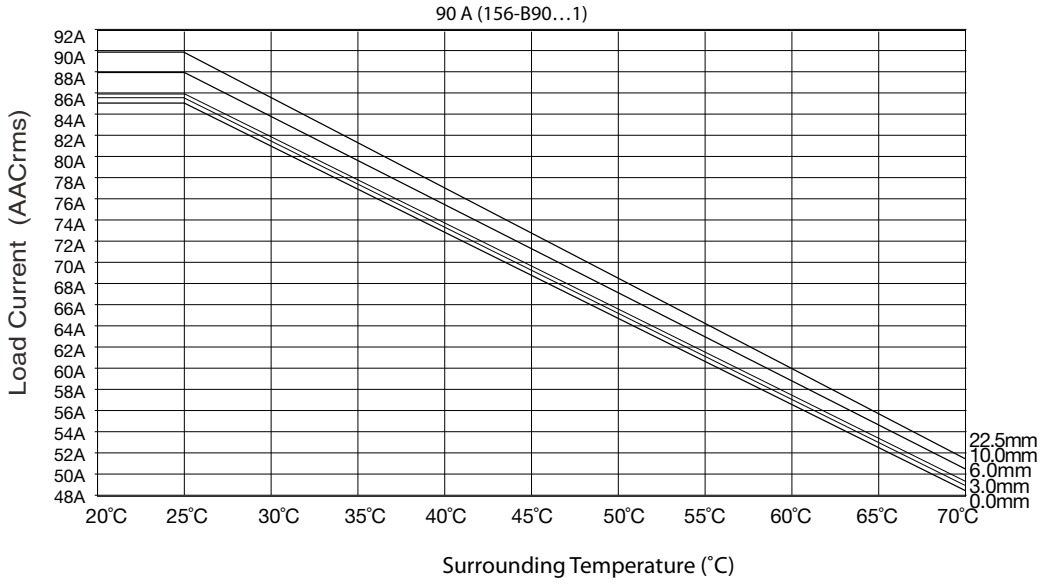


4

Panel Mounting Load Derating vs. Spacing Curves, Continued

Single-Phase

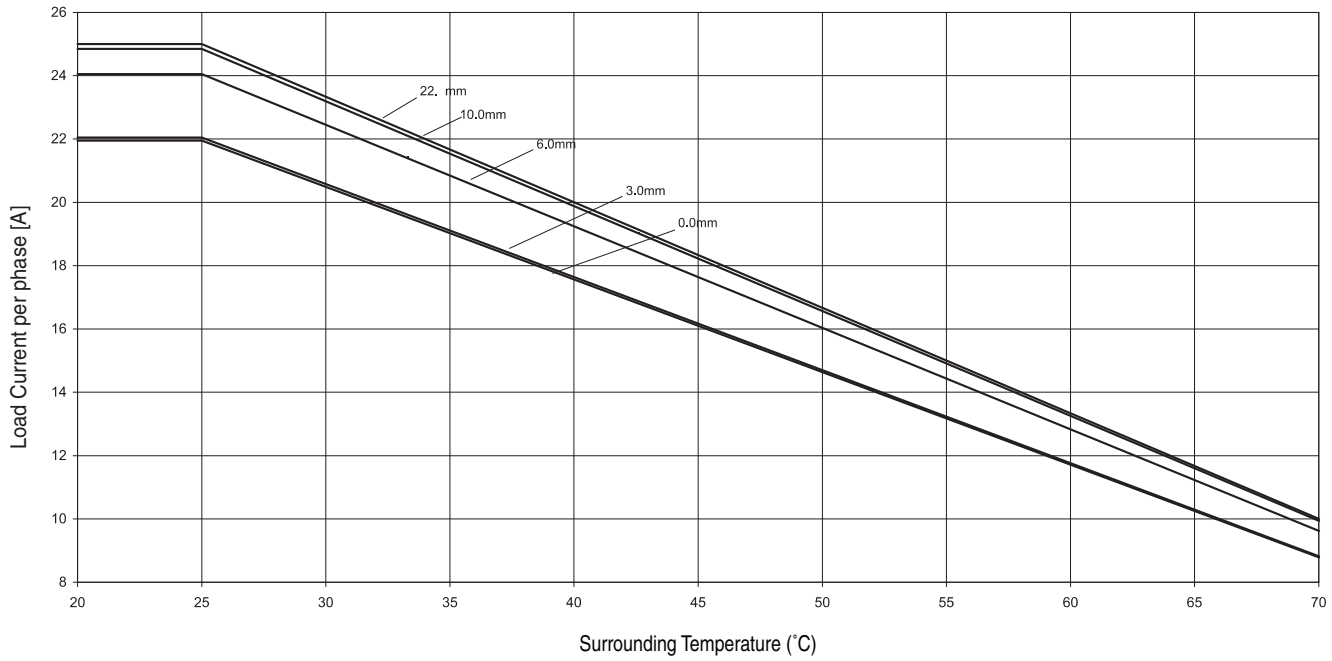




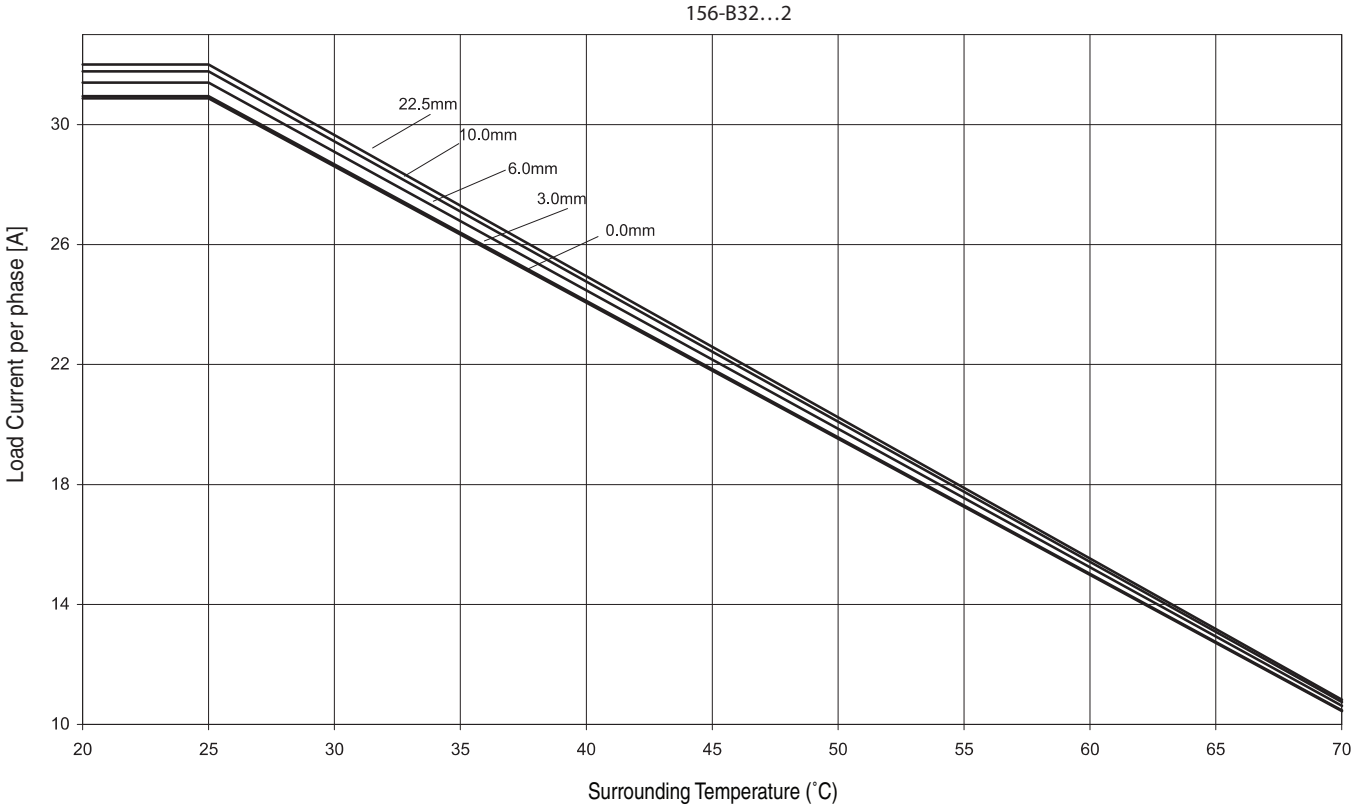
Panel Mounting Load Derating vs. Spacing Curves, Continued

Dual-Phase

156-B25…2



156-B32…2

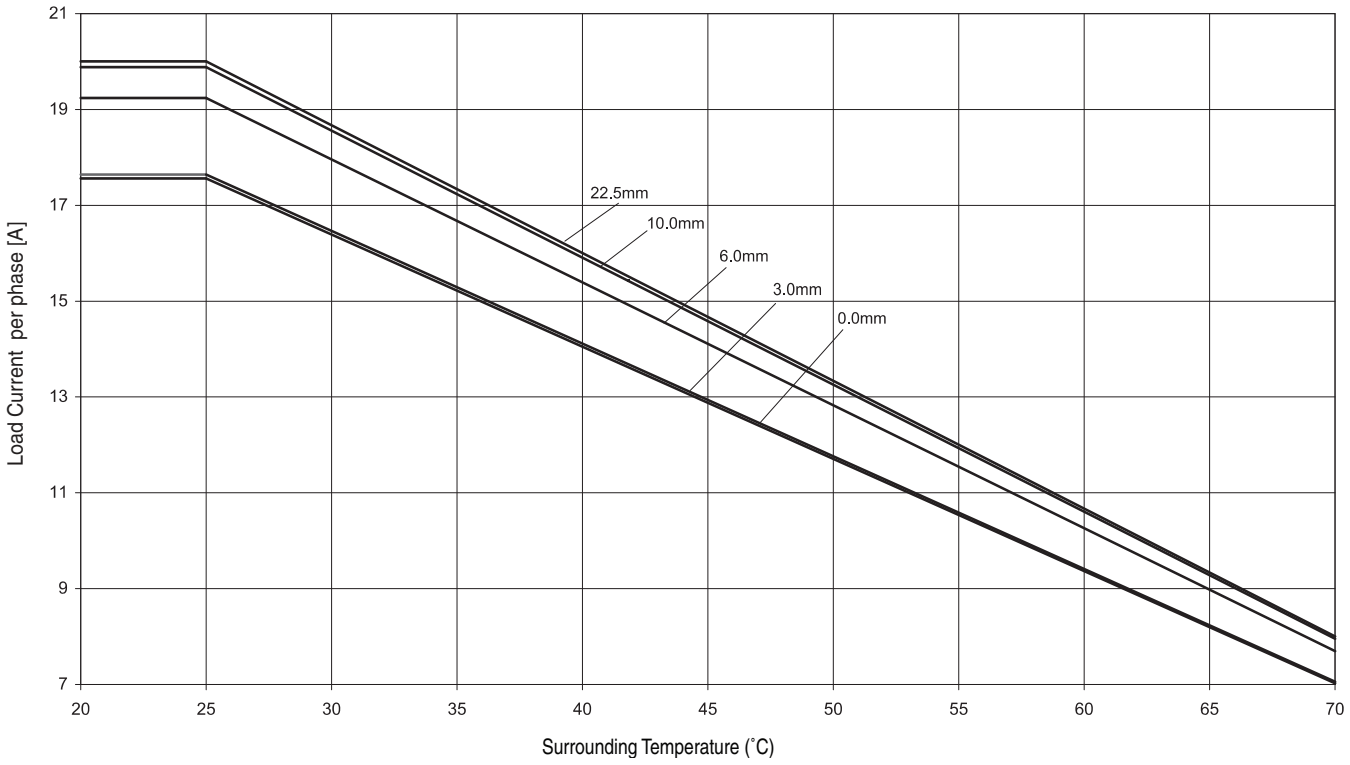


4

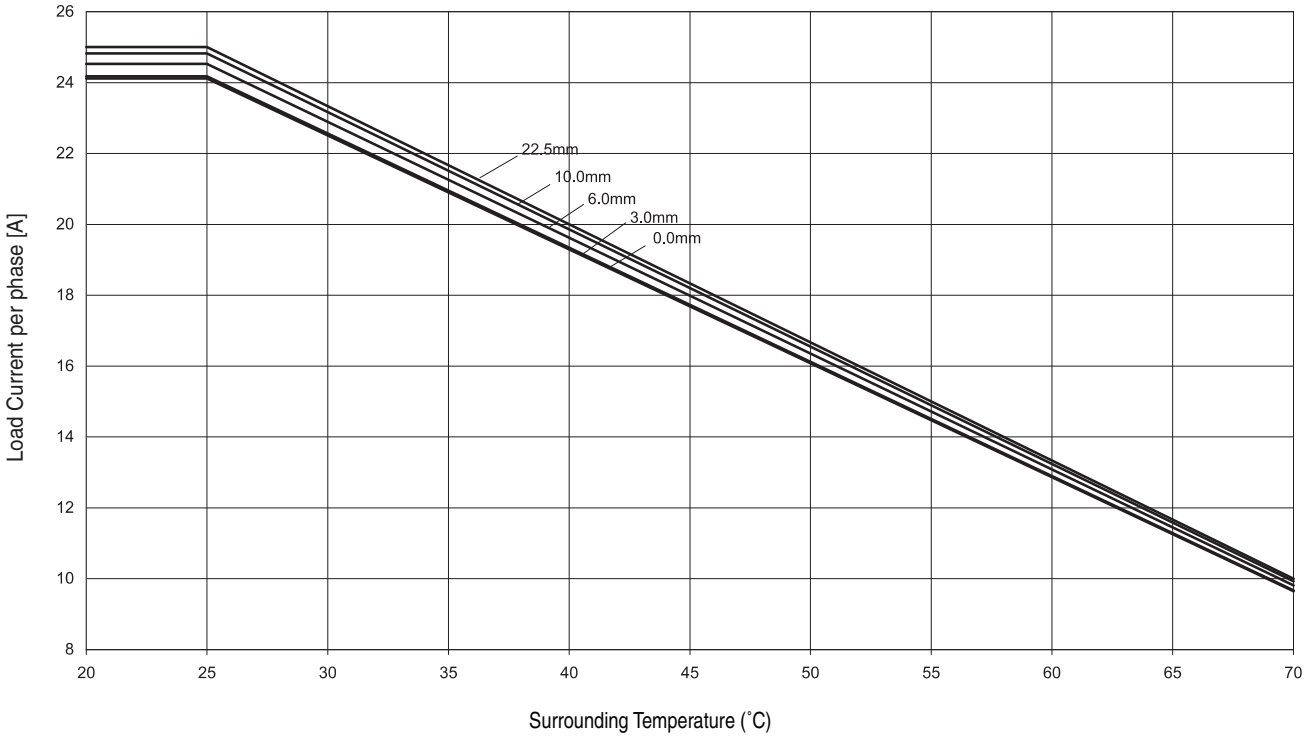
Panel Mounting Load Derating vs. Spacing Curves, Continued

Three-Phase

156-B20…3



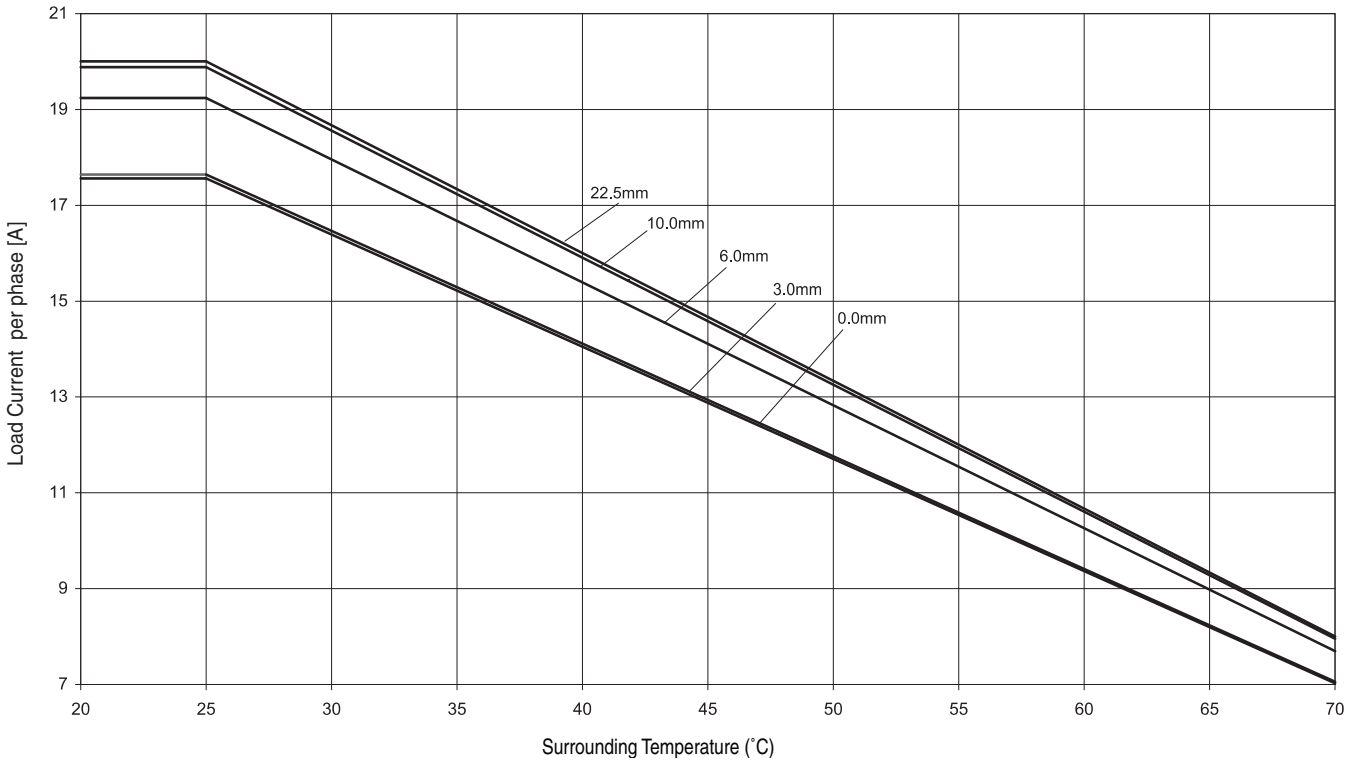
156-B25…3



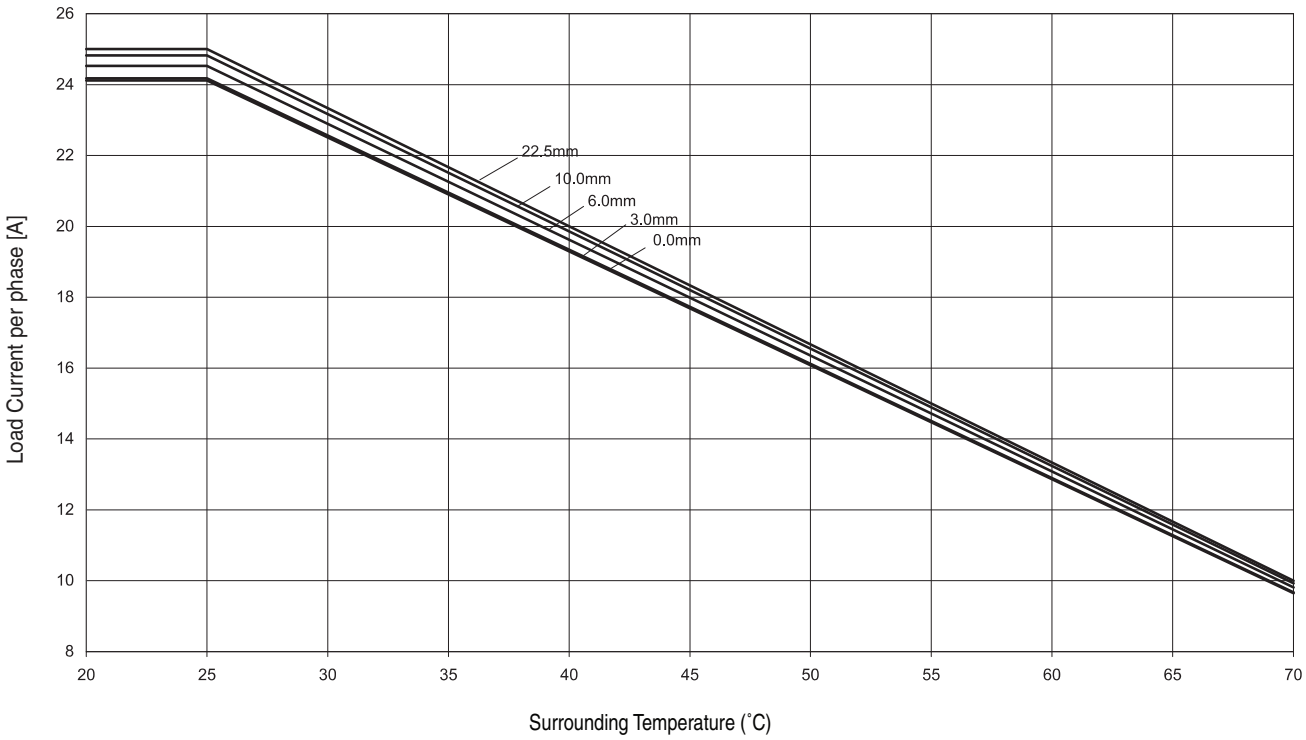
Panel Mounting Load Derating vs. Spacing Curves, Continued

Three-Phase

156-B20…3

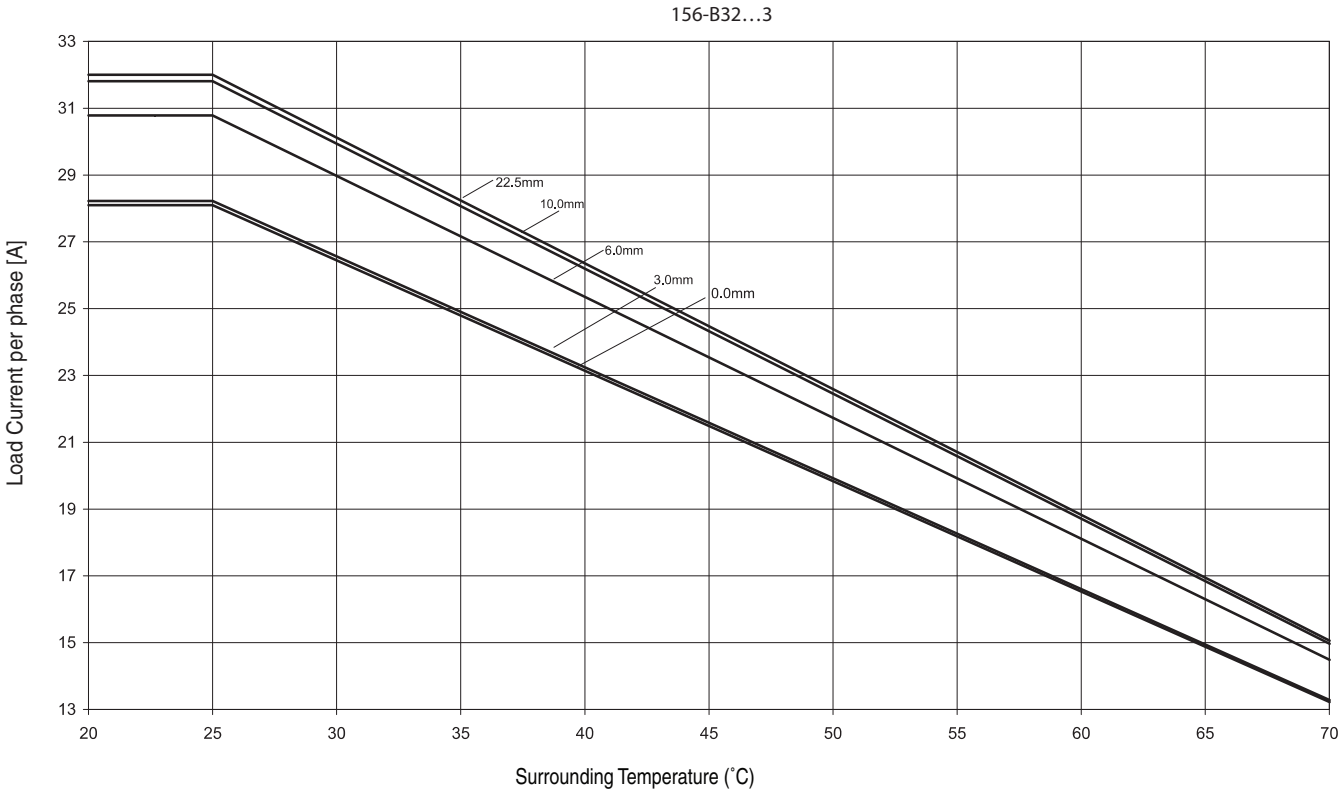


156-B25…3

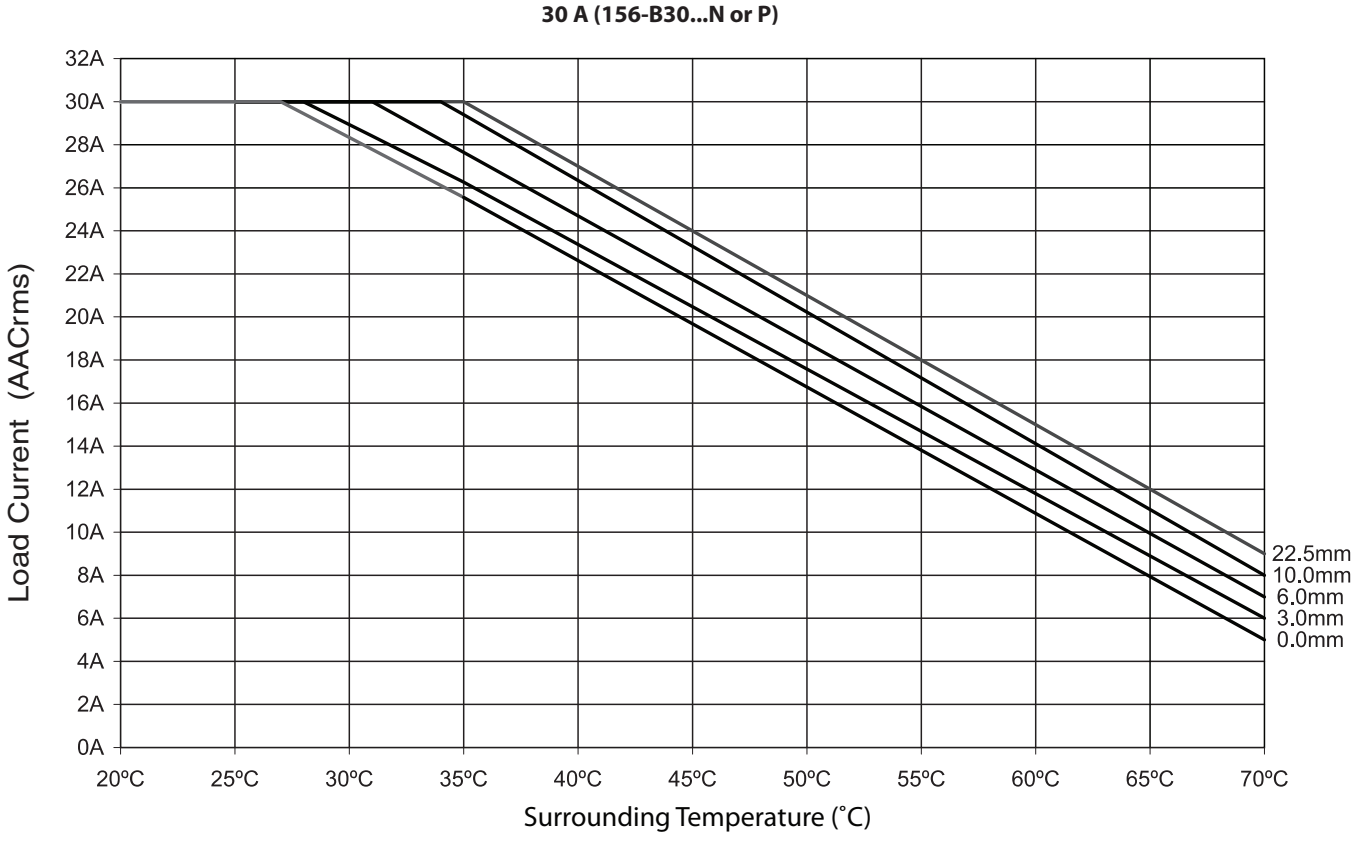


Panel Mounting Load Derating vs. Spacing Curves, Continued

Three-Phase

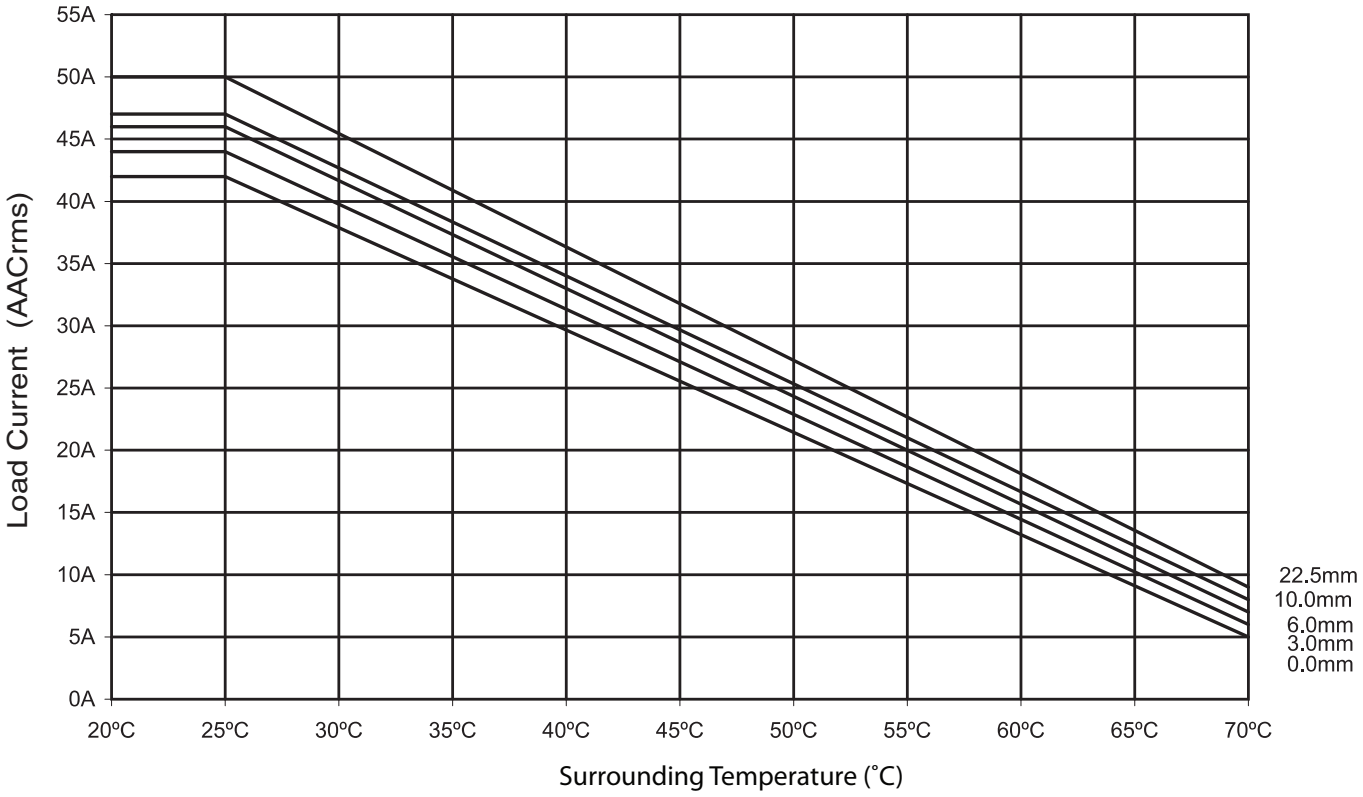


Single-Phase with Current Monitoring



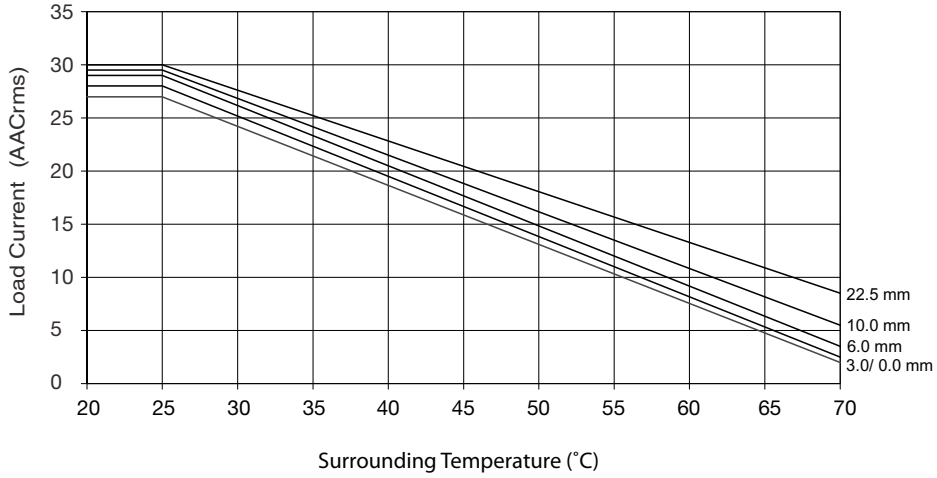
Panel Mounting Load Derating vs. Spacing Curves, Continued

50A (156-B50...N or P)

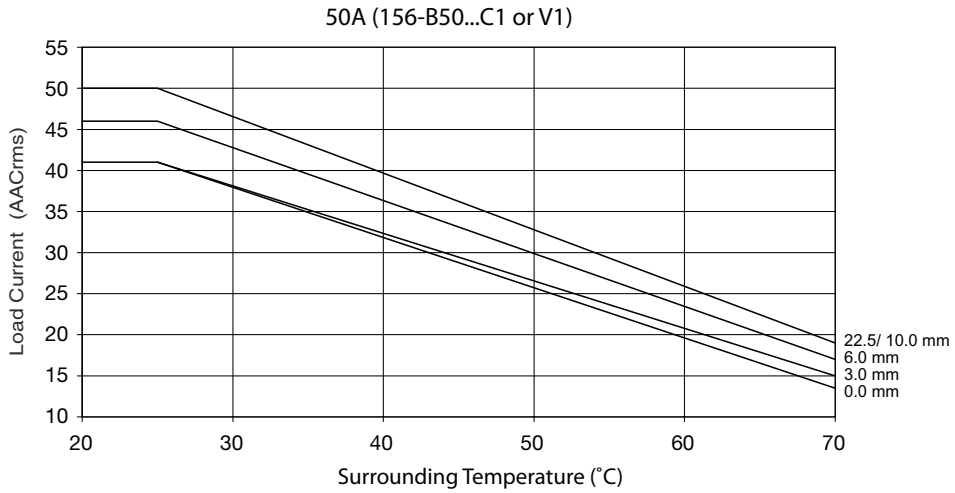


Multi-function Analog

30A (156-B30...C1 or V1)



Panel Mounting Load Derating vs. Spacing Curves, Continued



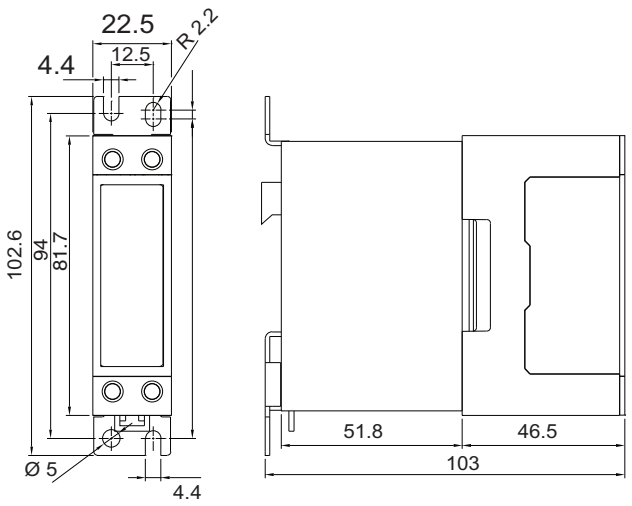
4

Approximate Dimensions

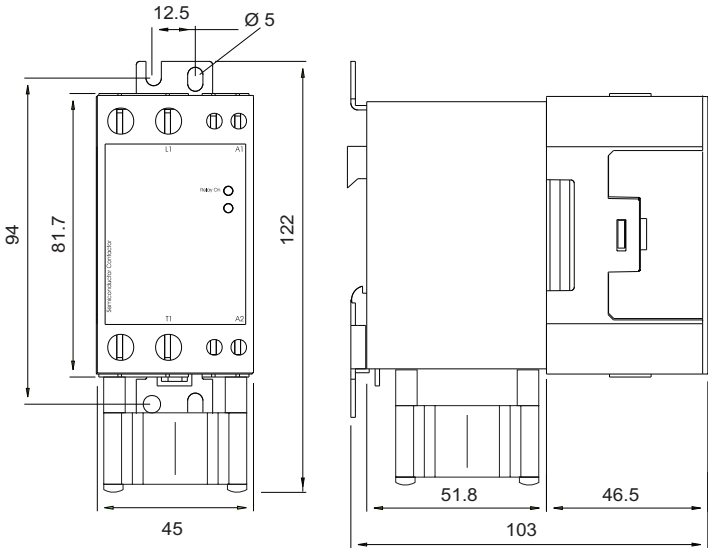
Dimensions in millimeters. Dimensions are not intended for manufacturing purposes.

Refer to column 3 of the Power Output table on page 4-172 for cat. no. dimension reference.

22.5 mm

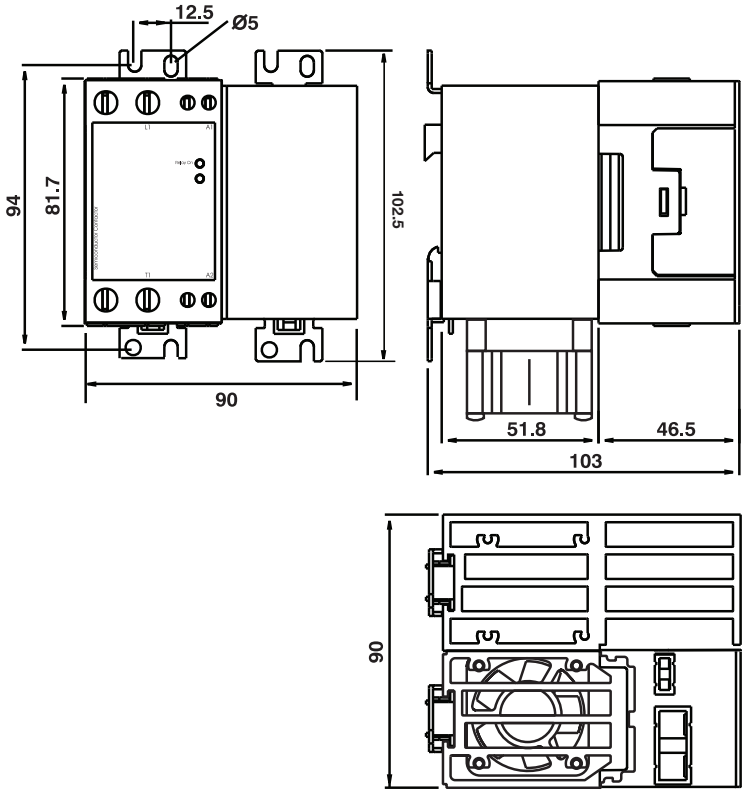


45 mm (shown with fan)§



§ The fan adds approximately 28 mm to the height of the SSC. Subtract 28 mm for the approximate height of SSCs without fans. Refer to page 4-169 for products with fans.

90 mm (shown with fan)§

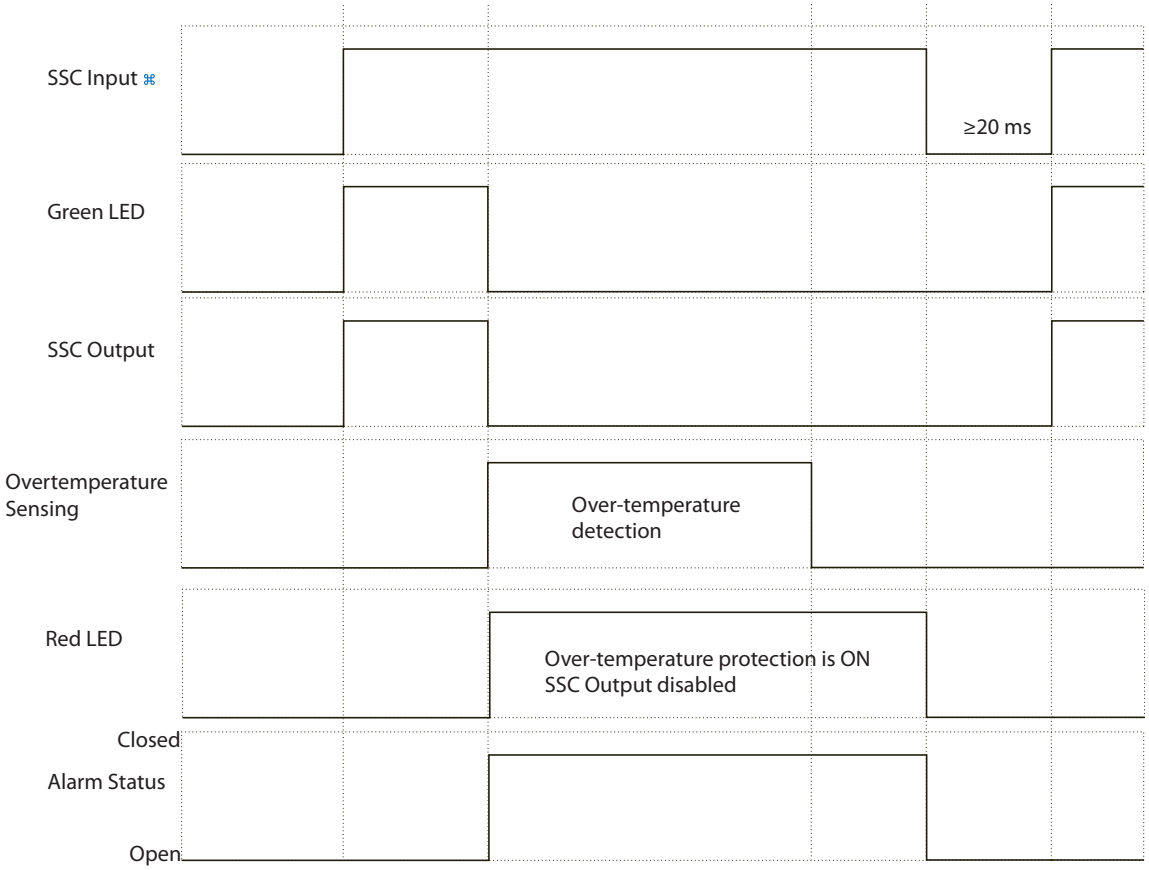


§ The fan adds approximately 28 mm to the height of the SSC. Subtract 28 mm for the approximate height of SSCs without fans. Refer to page 4-169 for products with fans.

Overtemperature Alarm Cutout/Protection Operation

The Bulletin 156-B… Solid-State Contactor (SSC) with a fan (Cat. Nos. 156-B75...1, 156-B90...1, and 156-B32...3) has an overtemperature alarm, cutout/protection feature. The cutout feature protects the SSC electronic switching circuit from overtemperature damage by automatically switching off the output (load) when the core temperature of the SSC exceeds 125 °C (257 °F). In this condition the fan will be running unless there is a fan circuit issue. When the cutout occurs the SSC red LED will light and if the alarm contact is wired it will close to notify a monitoring device such as the PLC of the condition. The following diagram provides additional details.

Note: For a standard unit without an overtemperature alarm. The SCO protective cutout feature still functions. When the unit cools to within allowable limits it returns to operation.



⌘ After over-temperature condition is removed, SSC can be reset by switching OFF the control input for more than 20 ms and switching back ON: this will switch ON the SSC output

Current Monitoring Operation

Product Description

The Bulletin 156-B… P or …N Current-Monitoring Solid-State Contactor (SSC) is a single-phase device that is sensitive to variations in load current conditions. This microprocessor-based device can detect a partial load failure and ensure the highest process quality. Current sensing is integrated inside to eliminate the need to install an external current transformer. A membrane TEACH button on the front is used to effect a simple “teach in” of the normal operating current setpoint. Alarm delay time is set by a potentiometer. Typical conditions that can be detected are heater break or open-circuit, blown fuse, semiconductor short-circuit and faulty power connection.

Alarm Operation

Current Setpoint
The current setpoint is the nominal operating current that is expected when all the heater loads are functioning properly. If the heater loads are faulty or the supply voltage is not close to the nominal level, the wrong setpoint will be stored during TEACH.

Initialization
As shipped, no setpoint is stored in the SSC flash memory. Both green and red LEDs will flash intermittently to indicate that a setpoint must be stored using the TEACH procedure. The load will **not** go on when the control is applied until a TEACH command is successful.

Local Functions
Local functions can be activated by using the TEACH push button on the front of the SSC. While an alarm is being issued by any SSC connected to the common alarm line or a remote command is being issued, no local commands are accepted.

Local RESET
When an alarm has occurred the device can be locally RESET by pressing the TEACH button for 1 second. The red LED will flash once. This will reset the alarm. If the alarm condition has been cleared the SSC will return to normal operation. If the alarm condition is still active, the SSC will automatically go back to alarm status.

Alarm Operation

Local TEACH
Press and hold the TEACH button for approximately 3 seconds. The red LED will flash after each second. After the LED flashes 3 times, release the button. If the "teach" command was accepted, the heater loads are automatically switched ON. The red LED will flash quickly 10 times. When the current setpoint has been stored successfully, the red and green LEDs will scroll intermittently to indicate that the TEACH procedure has been completed. The load will now be switched on or off according to the control input's status.

It is very important to hold the button down for only 3 flashes of the red LED to make a successful TEACH. If the TEACH procedure is not successful, the SSC will automatically reset to factory default (i.e., no setpoint stored).

Local TEST
In the absence of a signal on the "control input" terminal, a local TEST can be made by pressing and holding the TEACH button for 5 seconds. After the red LED flashes 5 times, release the button. The SSC will switch ON the load for 1 second. This test detects if there is an undercurrent or heater break alarm condition.

Remote Setup Procedure
Remote functions can be activated with a PLC or any other logic controller by applying timed pulses to the alarm terminal: >10V for Cat. No. 156-B…P and <10V for 156-B…N.

Remote TEACH
Apply a 3-second pulse. The red LED will flash after each second. After the LED flashes 3 times and the remote "teach" command has been accepted, the heater loads (of all SSCs connected to the same alarm line) are automatically switched ON and the red LED will flash quickly 10 times. When the current setpoint has been stored successfully, the red and green LEDs will scroll intermittently to indicate that the TEACH procedure has been completed. The load(s) will now be switched on or off according to the control input's status

Remote RESET/ UNBLOCK
When an alarm has occurred the SSC can be remotely RESET by applying a 1-second pulse. A 1-second pulse will also unblock local TEACH of all SSCs connected to the same alarm line. The red LED will flash once. This will reset the alarm. If the alarm condition has been cleared the SSC will return to normal operation. If the alarm condition is still active, the SSC will automatically go back to alarm status.

Remote BLOCK
Applying a 5-second pulse will force the SSC to block local TEACH. After this, no local TEACH commands are accepted. To unblock this condition, a remote RESET must be issued. If the 24V supply is removed, local TEACH BLOCK is lost. Another REMOTE BLOCK must be issued.

Alarms

Alarm DELAY
A potentiometer on the front of the SSC allows a time delay on the heater break alarm between 0…40 s.

For heaters having a low cold resistance, the time for the inrush current to decay to a value less than 13% of the current set-point plus an additional 20 ms must be added to the potentiometer alarm delay setting.

For an alarm signal to occur, the alarm condition must persist throughout this time period. The alarm output is enabled only after this time delay has passed. However, if the control input is disabled for a period of time equal to four times the delay setting, the internal alarm delay timer is reset automatically. (See Alarm Operation graphs.)

SSC remains OFF due to Line Voltage Loss or Thyristor Open Circuit Failure (Reaction Time = 85 ms)
The SSC generates one pulse with duration of 7 seconds on the alarm terminal. This alarm is non-latching. The red LED remains ON after this alarm condition until a RESET is issued.

Heater Break
A Heater Break alarm is given if the current measured through the SSC is 13% less than the current setpoint stored in the flash memory for a period of time greater or equal to the alarm delay potentiometer setting. The SSC generates one pulse with duration of 8 seconds on the alarm terminal. The alarm signal is non-latching. The red LED remains ON after this alarm condition until a RESET is made. If the measured current changes to within 10% of the Current Setpoint, before the Alarm DELAY time has elapsed, the Alarm DELAY timer is reset.

Overtemperature or Overcurrent
This alarm occurs if any one of following two conditions is true:
1. The SSC detects an internal over-temperature condition at any time during operation and switches off the output. The red LED flashes intermittently.
2. A current above the nominal SSC rating is measured during current setpoint TEACH. This action erases the current setpoint from flash memory and both red and green LEDs will flash intermittently until a TEACH procedure with an acceptable current is carried out.
In both cases, the SSC generates one pulse with duration of 9 seconds on the alarm terminal. The alarm signal is non-latching.

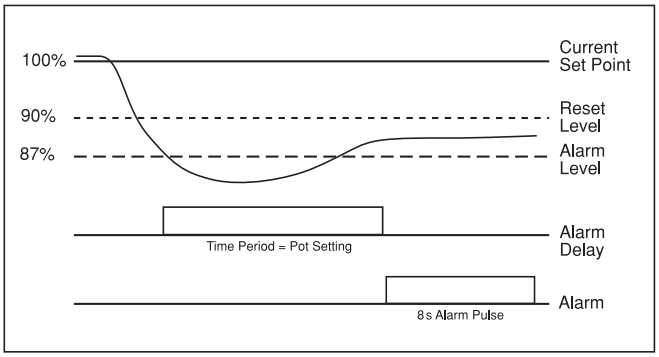
Thyristor Short-Circuit (Reaction time = 110 ms)
The SSC generates one pulse with duration of 10 seconds on the alarm terminal. The alarm signal is non-latching.
The red LED remains ON after this alarm condition until a RESET is made.

Alarms Connected in Parallel to one PLC Input and one PLC Output
For REMOTE operation, up to 50 SSCs can be connected in parallel to at least one PLC input. This PLC input must also be connected in parallel to the PLC output. The PLC input must be programmed to detect alarms while the PLC output must be programmed to supply the pulses required for REMOTE Setup. When more than one SSC is present, pulses from the PLC output or alarm pulses from any device will cause the red LEDs on all devices in parallel to flash intermittently for a max. of 6.25 seconds. After this time, it is only SSCs with an alarm condition that will have their red LED on.

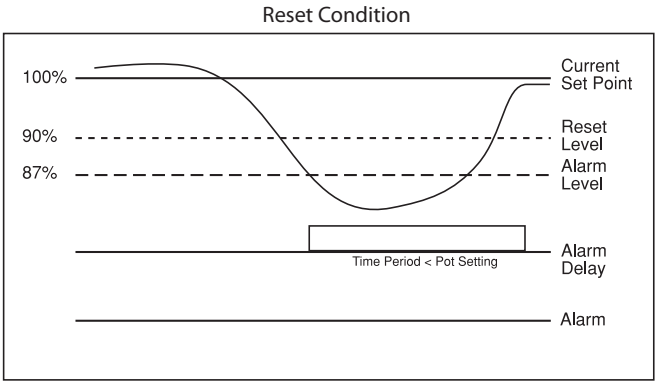
Example:

Set the alarm delay setting to 2 s (minimum). If the full load current is set at 30 A, then there will be an alarm condition if the current is under 26.1 A for more than 2 s. (Any fluctutation in the load current that is present for <2 s will not be signalled – this is intended to eliminate false alarms due to short duration undervoltage conditions on the supply phase). If the control input goes off within the 2 s, the alarm timer will not be reset provided the control input goes on again within 8 s (4x2 s).

Alarm Condition



Alarm Operation



Setup and Alarms

RESET	Remote reset	PLC output to alarm terminal high >1 s (<2 s)	1s
	Local reset	Push and hold button for >1 s (<2 s)	1s
	Visual indication	Red LED ON	
TEACH	Remote teach	PLC output to alarm terminal high >3 s (<4 s)	3s
	Local teach	Push and hold button for >3 s (<4 s)	3s
	Visual indication	Red LED ON	
TEST	Remote test	Not available	
	Local test	Push and hold button for >5 s (<6 s)	5s
	Visual indication	Red LED ON	
BLOCK	Remote block	PLC output to alarm terminal high >5 s (<6 s)	5s
	Local block	Not available	
	Visual indication	Red LED ON	
ALARMS	SSC remains OFF due to line voltage loss or thyristor open circuit fault	Transistor alarm non-latching pulse (7 s)	7s
	Control input ON	Green LED — full intensity	
	Visual indication	Red LED ON (latching)	
	Current under-range detected during TEACH	Transistor alarm non-latching pulse (7 s)	7s
	Visual indication	Red and Green LEDs flashing together	
	Control input	Green LED — full intensity	
	Heater break alarm	Transistor alarm non-latching pulse (8 s)	Alarm delay, 8s
	Visual indication	Red LED ON (latching)	
	Current over-range detected during TEACH	Transistor alarm non-latching pulse (8 s)	9s
	Visual indication	Red and Green LEDs flashing together	
	Control input	Green LED — full intensity	
	Reset	Local or remote 1 s pulse	1s
	Over-temperature alarm	Transistor alarm non-latching pulse (9 s)	9s
	Visual indication	Red LED flashing	
	SSC output	Output is switched off during an OTP alarm	
	Control input	Green LED — full intensity	
	Thyristor short-circuit	Transistor alarm non-latching pulse (10 s)	10s
	Visual indication	Red LED ON (latching)	

Product Description

The Bulletin 156-B… Analog Control Solid-State Contactor (SSC) is a single-phase device that provides proportional output power in relation to the analog control signal level applied. This microprocessor-based device provides 5 different switching modes integrated into one package. A selector switch on the front of the device is used for the selection of the preferred mode of operation, i.e., either Phase Angle, Distributed Full Cycle, or Burst Control. This multi-function selection makes this SSC ideal for the control of a variety of loads, including heaters and lamps. The control signal can be either 4…20 mA or 0…10V DC. 4 mA or 0V correspond to zero output power, and 20 mA or 10V DC correspond to full output power.
The product is ready to mount on DIN Rail or chassis and comes with an integral heatsink.

Operation

MODE 1:
The Phase Angle switching mode works in accordance with the phase angle control principle, i.e. the output switching point in the AC sine wave depends on the signal level applied at the input. The SSC switches off every time the output current crosses zero. See Figure 1.
MODE 2:
The Distributed mode provides a number of full cycles, evenly distributed over a fixed period of 1.28 s @ 50 Hz (1.07 s @ 60 Hz), depending on the control input. Example: with 50% control input, the SSC output will be on for one cycle and off for one cycle. See Figure 2.
MODE 3, 4, 5:
The Burst Switching mode generates a number of full cycles, depending on the control input over fixed periods of 1 s, 3 s or 10 s for MODES 3, 4 and 5 respectively.
Example: with Mode 4 (3-second burst) configured and 50% control input, the SSC output will be on for 1.5 s and off for 1.5 s. See Figure 3.
Modes 2, 3, 4 and 5 use the zero switching principle, thus ensuring a reduced level of radiated and wire-conducted noise. The Distributed and Burst Switching modes are not recommended for light control due to light-flickering.

LED Indication
The top RED LED indicates the load status. It goes ON whenever the load is activated. The Green LED gives indication of the status of the control input.
Upon application of control current (for the cat. no. 156-Bxx…C1) to terminals A1 – A3, the Green LED will be dimly lit, with its intensity increasing with an increase in control current.
For the cat. no. 156-Bxx…V1, the Green LED will be ON (flickering) upon application of the supply voltage to terminals A2 – A4. Once a control voltage is applied to terminals A1 – A3, the Green LED will be fully ON, if greater than a threshold voltage (approx 0.5V). Note that the first time the device (voltage control version) is to be activated, the mains voltage has to be present for the Green LED to indicate the control status.

Transfer Characteristics

Output power as a function of control input

Control Current [mA]	Control Voltage [V DC]	Output Power [%]‡
4	0	0
8	2.5	25
12	5	50
16	7..5	75
20	10	99

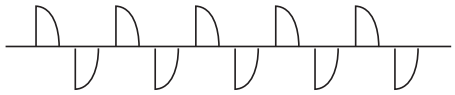
‡ Time for SSC to process analog changes: 15…20 ms

Mode Selection

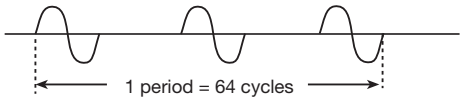
- Mode 1 | Phase Angle Switching
- Mode 2 | Distributed Control
- Mode 3 | Burst Switching (1 s period)
- Mode 4 | Burst Switching (3 s period)
- Mode 5 | Burst Switching (10 s period)

Functional Diagram

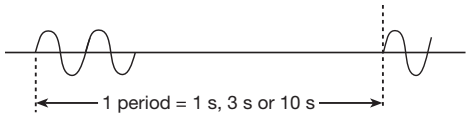
MODE 1
Phase angle
Figure 1



MODE 2
Distributed Full Cycle
Figure 2



MODE 3, 4, 5
Burst 1 s, 3 s, 10 s
Figure 3



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